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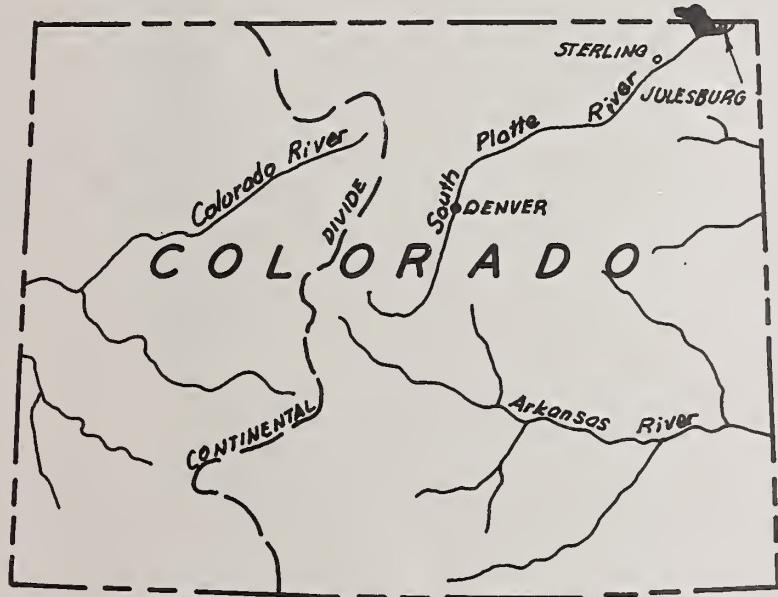


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WATERSHED WORK PLAN

**SEDGWICK-SAND DRAWS WATERSHED**

**CHEYENNE & DEUEL COUNTIES, NEBRASKA  
SEDGWICK COUNTY, COLORADO**



Prepared under the authority of the Watershed Protection & Flood Prevention Act  
(Public Law 566, 83rd. Congress, 68 Stat. 666) as amended.

USDA-SCS-PORTLAND, OREG. 1975

**JANUARY 1975**



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## WATERSHED WORK PLAN

### SEDGWICK-SAND DRAWS WATERSHED

Sedgwick County, Colorado  
Cheyenne and Deuel Counties, Nebraska

Prepared under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

#### Prepared By:

Sedgwick County Soil Conservation District  
Sedgwick-Sand Draws Watershed Conservancy District  
Sedgwick County Board of Commissioners  
Julesburg Irrigation District  
Town of Ovid and the  
Colorado State Soil Conservation Board  
in Colorado

South Platte Natural Resources District  
in Nebraska

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#### With Assistance By:

U.S. Department of Agriculture, Soil Conservation Service  
U.S. Department of Agriculture, Forest Service  
Colorado Water Conservation Board  
Colorado Division of Wildlife  
Colorado State Forester  
Nebraska Natural Resources Commission  
Nebraska State and Extension Forester

January 1975



## SEDGWICK-SAND DRAWS WATERSHED WORK PLAN

## Contents

	Page(s)
WATERSHED WORK PLAN AGREEMENT -----	<i>i - viii</i>
Summary of Plan -----	1
Watershed Resources - Environmental Setting -----	6
Water and Related Land Resource Problems -----	17
Projects of Other Agencies -----	26
Project Formulation -----	27
Works of Improvement to be Installed -----	33
Explanation of Installation Costs -----	42
Effects of Works of Improvement -----	46
Project Benefits -----	52
Comparison of Benefits and Costs -----	54
Project Installation -----	55
Financing Project Installation -----	64
Provision for Operation and Maintenance -----	66

## Tables Section

1      Estimated Project Installation Cost -----	70
1A     Status of Watershed Works of Improvement -----	71
2      Estimated Structural Cost Distribution -----	72
3      Structural Data (Structures with Planned Storage Capacity) -----	73
3A     Structural Data (Floodways) -----	75
3B     Structural Data (Floodway Stabilization Structures) -----	76

## Tables Section (Contd)

	Page(s)
3C Structural Data (Grade Stabilization and Water Control Structures) -----	77
4 Annual Cost -----	78
5 Estimated Average Annual Flood Damage Reduction Benefits -----	79
6 Comparison of Benefits and Costs for Structural Measures -----	80

## Investigations & Analyses Section

Land Use and Treatment -----	81
Fish, Wildlife and Recreation -----	81
Hydrology and Hydraulics Investigations -----	82
Engineering Investigations -----	84
Cost Estimates -----	85
Geologic Investigations -----	85
Sedimentation Investigations -----	86
Economic Investigations -----	87

## Maps and Exhibits Section

Figure 1 - Floodwater Retarding Structure SS-3,  
Topographic Map of Reservoir and Dam Site

Figure 2 - Floodwater Retarding Structure SS-3,  
Cross-Section of Dam on E of Principal Spillway

Figure 3 - Channel Profile, Floodway 1

Figure 4 - Channel Profile, Floodway 1

Maps & Exhibits Section (Contd)

Figure 5 - Channel Profile, Floodway 1

Figure 6 - Channel Profile, Floodway 2

Figure 7 - Channel Profile, Floodway 2

Figure 8 - Flood Plain Damage Map, Ovid

Figure 9 - Channel Profile, Ovid Floodway

PROJECT MAP

ADDENDUM



WATERSHED WORK PLAN AGREEMENT

between the

Sedgwick County Soil Conservation District  
Local Organization

Sedgwick-Sand Draws Watershed Conservancy District  
Local Organization

Sedgwick County Board of Commissioners  
Local Organization

Julesburg Irrigation District  
Local Organization

Town Council of Ovid  
Local Organization

Colorado State Soil Conservation Board  
Local Organization

in Colorado; and

South Platte Natural Resources District  
Local Organization

in Nebraska

(hereinafter referred to as the Sponsoring Local Organizations)

and the

Soil Conservation Service  
United States Department of Agriculture  
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Sedgwick-Sand Draws Watershed, States of Colorado and Nebraska under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Congress, 68 Stat. 666) as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Sedgwick-Sand Draws Watershed, States of Colorado and Nebraska, hereinafter referred to as the *Watershed Work Plan*, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organizations will acquire, with other than Public Law 566 funds, such land rights as will be needed in connection with the works of improvement. (Estimated cost \$159,520.)
2. The Sponsoring Local Organizations assure that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organizations and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	33.1	66.9	\$0 <u>1/</u>

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Works of Improvement			
Floodwater Retarding Structures SS-1, SS-2, SS-3, SS-4, SS-4.5, SS-5, SS-6, SS-7, SS-8, SS-8.5, Grade Stabilization Structures GS-2.1 GS-2.2 and GS-6			
Canal Inlets (10 drops)			
Floodway Improvement: Floodways 1, 2 and Ovid Floodway	0.0	100.0	1,653,090

5. The percentages of engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Costs</u> (dollars)
Floodwater Retarding Structures: SS-1,SS-2, SS-3,SS-4,SS-4.5,SS-5, SS-6,SS-7,SS-8,SS-8.5			
Grade Stabilization Structures: GS-2.1, GS-2.2 and GS-6			
Canal Inlets (10 drops)			
Floodway Improvement: Floodways 1, 2, and Ovid Floodway	0.0	100.0	\$231, <sup>4</sup> 30

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$16,530 and \$264,490, respectively.
7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Sponsoring Local Organizations will encourage land-owners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised and this agreement may be modified or terminated only by mutual agreement of the parties hereto.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provides that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Sedgwick County Soil Conservation District By \_\_\_\_\_  
Local Organization

Title \_\_\_\_\_

Address Zip Code  
Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Sedgwick County Soil Conservation District  
Local Organization

adopted at a meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code  
Date \_\_\_\_\_

Sedgwick-Sand Draws Watershed  
Conservancy District  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the  
governing body of the Sedgwick-Sand Draws Watershed Conservancy District  
Local Organization  
adopted at a meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code \_\_\_\_\_

Date \_\_\_\_\_

Sedgwick County Board of Commissioners  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the  
governing body of the Sedgwick County Board of Commissioners adopted  
Local Organization  
at a meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code \_\_\_\_\_

Date \_\_\_\_\_

Julesburg Irrigation District  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the  
governing body of the Julesburg Irrigation District adopted at a  
Local Organization  
meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code \_\_\_\_\_

Date \_\_\_\_\_

Town Council of Ovid  
Local Organization By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Town Council of Ovid adopted at a meeting Local Organization held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code

Date \_\_\_\_\_

Colorado State Soil Conservation Board  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Colorado State Soil Conservation Board Local Organization

adopted at a meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code

Date \_\_\_\_\_

South Platte Natural Resources District  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address Zip Code Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the South Platte Natural Resources District Local Organization

adopted at a meeting held on \_\_\_\_\_

Secretary, Local Organization Address Zip Code

Date \_\_\_\_\_

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service  
United States Department of Agriculture

Recommended by:

Approved by:

---

State Conservationist

---

Administrator

---

Date

---

Date

# WATERSHED WORK PLAN

## SEDGWICK-SAND DRAWS WATERSHED

COLORADO AND NEBRASKA

JULY 1974

### SUMMARY OF THE PLAN

#### Description, Size and Location

The Sedgwick-Sand Draws Watershed covers an area of 104.2 square miles or 66,714 acres in parts of Sedgwick County, Colorado and Cheyenne and Deuel Counties, Nebraska. The watershed is 17 miles in length, averages about six miles in width, and consists of 16 southeasterly-trending ephemeral watercourses, mostly unnamed, which originate mainly in Nebraska and flow into the South Platte River in Colorado.

Twenty percent of the watershed is irrigated cropland, 41 percent is nonirrigated cropland, 36 percent is rangeland, and 3 percent is miscellaneous. Ninety percent of the watershed is private land and 10 percent is state land. Land values per acre are \$550 for irrigated cropland and urban land; \$125 for nonirrigated cropland, and \$60 for rangeland.

#### Sponsoring Organizations

This work plan was prepared by the Sedgwick County Soil Conservation District, the Sedgwick-Sand Draws Watershed Conservancy District, the Sedgwick County Board of Commissioners, the Julesburg Irrigation District, Town Council of Ovid and the Colorado State Soil Conservation Board in Colorado, and by the South Platte Natural Resources District in Nebraska.

Technical assistance was provided by the U.S. Department of Agriculture through the Soil Conservation Service and the Forest Service, the Colorado Division of Wildlife, the Colorado State Forester, the Nebraska State and Extension Forester, and the Nebraska Natural Resources Commission.

## Summary

Other agencies and organizations who assisted in preparation of the work plan or provided technical data for the work plan are:

### Local

Highline Rural Electric Association  
Union Pacific Railroad Company  
Curator, University of Colorado Museum

### State

Colorado Board of Land Commissioners  
Colorado Division of Water Resources  
Colorado Division of Highways  
Colorado Water Conservation Board  
Colorado State Historical Society  
Nebraska Board of Educational Lands and Funds  
Nebraska State Historical Society

### Federal

Agricultural Research Service  
Agricultural Stabilization and Conservation Service  
Bureau of Sport Fisheries and Wildlife  
U.S. Geological Survey  
National Weather Service  
National Park Service, Midwest Archeological Center  
Environmental Protection Agency

## Watershed Problems

The major watershed problem is frequent floodwater, sediment and erosion damage that results from runoff produced by high intensity summer thunderstorms.

Damage occurs throughout the flood plain to agricultural land, crops, irrigation facilities, the railroad, roads and bridges, parts of the residential section of the town of Ovid, Colorado and other improvements in the flood plain.

## Project Objectives

The project objective is to reduce damages from floodwater, erosion and sediment to agricultural land, crops, irrigation systems, wildlife habitat, roads and the railroad, farmsteads and the town of Ovid, Colorado. The town of Ovid is to be protected from the 100-year frequency storm event. Level of protection to the remaining

flood plain varies from a 50-year level at the floodwater retarding structures to a 5-year level at Highway 138. Consideration will be given to measures that create, preserve and enhance watershed values for wildlife and natural beauty and to measures that reduce environmental pollution.

#### Works of Improvement to be Installed

The project measures include a program of land treatment and structural measures with a total project cost of \$3,215,510. Public Law 566 funds are to provide \$2,150,510 and other funds are to provide \$1,065,000. The project is to be constructed over a 5-year installation period.

#### LAND TREATMENT MEASURES

Land treatment measures to be applied include practices for watershed protection, fire control intensification, land and vegetative improvement, tree plantings for windbreaks and wildlife food and shelter, irrigation water management and wildlife habitat management and enhancement. Land treatment measures will be established by the landowners and operators on private and state land in cooperation with the Soil Conservation and Natural Resources Districts, the Colorado Division of Wildlife and the State Foresters.

Costs for the land treatment measures are estimated at \$890,450 all of which will be provided by funds other than P.L. 566 funds, except for \$1,500 of P.L. 566 funds for accelerated technical assistance to Colorado rural fire districts.

#### STRUCTURAL MEASURES

The structural measures included in the plan consist of 10 single purpose floodwater retarding structures, three grade stabilization structures, three floodways and 10 canal inlet structures. The floodwater retarding structures have combined capacities of 5,731 acre-feet for floodwater detention and sediment accumulation and are designed as dry dams. The combined length of the three floodways is about 7.9 miles.

The estimated installation cost of the structural measures for flood protection is \$2,325,060. Public Law 566 share is estimated to be \$2,149,010. Other funds are to provide \$176,050.

## Summary

### Operation and Maintenance

The project land treatment measures will be maintained by the land-owners and operators of the private and leased state land on which the measures are installed.

Rural fire districts are needed to maintain and protect land treatment measures and improvements. Technical assistance to landowners and rural fire districts for operating and maintaining forestry and fire control measures beyond the installation period will be provided by the respective state foresters in cooperation with the U.S. Forest Service under regular continuing programs.

The Colorado Division of Wildlife will operate and maintain wildlife food and cover plantings and continue management practices on the Sedgwick Bar State Wildlife Area from funds allocated for this purpose. All maintenance will be done as needed.

The Colorado Watershed and RC&D Operation and Maintenance Handbook will be provided Sponsors for guidance in fulfilling their obligations for structural measures operation and maintenance. The estimated operation and maintenance cost is \$12,675 annually.

The *Julesburg Irrigation District* will assume operation and maintenance responsibility for the following at an estimated cost of \$5,525 annually:

1. Ten canal inlet structures into Highline Canal.
2. All gates and structures within Julesburg Irrigation System including Floodways 1 and 2 from Highline Canal to outlets from Petersen Ditch.
3. Floodways (spillways) 1 and 2 between the Highline Canal and Petersen Ditch.

The *Sedgwick-Sand Draws Watershed Conservancy District* will assume operation and maintenance responsibility for the following at an estimated cost of \$6,730 annually:

1. Ten floodwater retarding structures and spillways.
2. Three grade stabilization structures.
3. The sections of Floodways 1 and 2 from Petersen Ditch to South Platte River.

The Sedgwick County Commissioners will assume operation and maintenance responsibility for the following:

1. Three county road bridges across Floodway 2.
2. Assistance to other sponsors whenever possible with maintenance needs of structural program.

The Town of Ovid will assume operation and maintenance for the Ovid Floodway estimated at \$420 annually. The Union Pacific Railroad will maintain their new street bridge over the Ovid Floodway. All maintenance will be done as needed.

#### Benefits and Costs

Average annual benefits accruing to the project are estimated at \$197,210. Of this \$9,440 accrues annually from land treatment measures. The remaining \$187,770 accrues from structural measures with estimated flood damage reduction benefits of \$123,490, more intensive land use benefits of \$46,470, and secondary benefits of a local nature, \$17,810.

The average annual project cost of the structural measures amortized at 5-1/2 percent over 100 years is \$141,160 including \$12,675 for operation and maintenance. All project costs are allocated to flood prevention. The ratio of the annual benefits \$187,770 to annual costs, \$141,160, is 1.3 to 1.0.

## WATERSHED RESOURCES - ENVIRONMENTAL SETTING

### Physical Data

The Sedgwick-Sand Draws Watershed is located in the southeast corner of Cheyenne County and the southwest corner of Deuel County, Nebraska and in the north central part of Sedgwick County in northeastern Colorado at latitude 41 degrees - 00' and longitude 102 degrees - 30'.

The watershed contains approximately 66,714 acres (104.2 square miles) of which 11,000 acres (17.2 square miles) are in Cheyenne and 24,005 acres (37.5 square miles) are in Deuel County, Nebraska and 31,709 acres (49.5 square miles) are in Sedgwick County, Colorado.

The following towns with their 1970 populations are within the watershed boundaries: Sedgwick, Colorado (population 208) and Ovid, Colorado (population 463). Towns near the watershed include: Julesburg, Colorado (population 1,578), the county seat of Sedgwick County located eight miles east of the watershed; Chappell, Nebraska (population 1,204), the county seat of Deuel County located five miles north of the watershed; Sidney, Nebraska (population 6,403), the county seat of Cheyenne County located 18 miles northwest of the watershed; and Sterling, Colorado (population 10,636), located 50 miles southwest of the watershed. The closest metropolitan area is Denver, Colorado, located 175 miles southwest of the watershed.

The watershed is in the South Platte River subregion of the Missouri Water Resource Region as delineated by the Water Resources Council. The area is described as Central High Tablelands comprised of relatively flat land draining into the Platte and Republican River Drainages. The watershed area is typical of the water resource region.

The upper part of the watershed consists mainly of a flat to gently undulating plain that is dissected towards its southern margins in Nebraska by numerous small, ephemeral watercourses draining southeastward to the tributary drainages in Colorado, the largest of which are Sedgwick Draw and Sand Draw. These drainages coalesce at their lower ends into a broad alluvial plain bordering the north sides of the flood plain of the South Platte River. Two of these tributary drainages originate in Nebraska and flow eastward into Lodgepole Creek which, in turn, flows southward into Colorado and enters the South Platte River southeast of Ovid, Colorado.

Damage from floodwater, erosion, and sediment runoff caused by high intensity, short duration summer thunderstorms is the major problem in the watershed. Runoff from the upper watershed does not follow

## Watershed Resources

natural courses to the river because of irrigation canals, roads, farms, and the Union Pacific Railroad constructed across the drainages. The problem areas are primarily in the middle and lower parts of the watershed paralleling the South Platte River.

The climate is classed as semi-arid. Average annual precipitation at Sedgwick is 17.01 inches. Periods of low rainfall are common with an uneven distribution of precipitation from year-to-year. The principal source of precipitation that causes damaging flood-water and sediment runoff is from high-intensity, short duration convection-type thunderstorms occurring over rather limited areas, normally in the period from April to October.

The greatest 24-hour amount of precipitation recorded at the Weather Bureau station 5 miles south of Sedgwick was 5.00 inches on May 5, 1969. A number of amounts in excess of 5.00 inches were reported in farm gages throughout the watershed in 1965 and 1968.

Temperature has ranged from a low of -40 degrees F. to a high of 110 degrees F. with an average annual temperature of 50 degrees F. The average frost-free growing season is 143 days based on 56 years of Weather Bureau records at Julesburg, Colorado.

Altitudes range from about 4,150 feet at the northwestern edge of the watershed to 3,510 feet at the southeastern edge of the watershed near Ovid, Colorado.

Geologic formations exposed within the watershed consist of rocks and sediments of Tertiary and Quaternary ages. Bedrock occurring at or near the surface at the lower ends of the tributary drainages consists predominantly of blocky claystone and siltstone of the Brule formation of Tertiary age. In the upper part of the watershed, these rocks are overlain by the Ogallala formation of Tertiary age, which consists of beds of stream-deposited gravel, sand, silt, and clay. Some of the sand and gravel of the Ogallala is cemented by calcium carbonate, which forms a rock ranging from a soft friable sandstone to a relatively hard sandstone.

Much of the middle part of the watershed is underlain by Pleistocene terrace deposits consisting of alluvial sands, silts and clays. Throughout most of the upper and middle portions of the watershed, the surface is mantled with wind-deposited silt and clay or silt and fine sand of Pleistocene age. The alluvial plain in the lower part of the watershed is underlain by stream-deposited silt, clay and sand of Pleistocene and Recent Ages.

Soils of the watershed are mainly deep or moderately deep loams or sandy loams. In the nonirrigated cropland area in the upper watershed, the soils on slopes below nine percent are high-producing wheatland, and the land now in cultivation has lost little surface soil. Steeper lands are mostly in native grass. Cover is such that there are no areas of critical erosion or sediment production.

The soils along the drainage slopes vary from silty loams to sandy loams to coarse gravel. The soil series are Colby silt loam, Bridgeport loam, Havre loam, Epping and Keota loams, Ascalon sandy loam, Chappell sandy loam, Dix and sandy alluvials. Except for the Epping and Keota soils, all have good hydrological ratings. All have good vegetative cover.

The soils of the irrigated area are mainly Keith-Tripp-Bridgeport Associations. Long-time yield records show that these soils are consistently highly productive. In the extreme lower part of the watershed adjacent to the South Platte River flood plain, a saline condition exists in some areas due to the low gradient from adjacent land to the South Platte River.

Soil surveys have been made and published for most of the watershed area. These include: Deuel County, Nebraska issued June 1965 and Sedgwick County, Colorado issued December 1969.

There is no assured water source from the watershed. Small flood flows from the upper plains are often taken into the irrigation canals that traverse the watershed and put to beneficial uses. The larger flows fill and overtop the canals.

Irrigated lands in the watershed are served primarily by gravity flow diversion from the South Platte River with storage in the Julesburg (Jumbo) Reservoir west of the watershed. The Julesburg Irrigation District owns the Julesburg Reservoir and the Highline Canal that distributes the stored water to the irrigated lands in Colorado and Nebraska. The Settlers Ditch, a pickup and distribution canal and the Petersen Ditch, which diverts out of the South Platte just west of Sedgwick, Colorado are also part of the system traversing the watershed and serving the irrigated lands below Highline Canal.

The Petersen, unlike the other two canals, continues east of the watershed across Lodgepole Creek and serves irrigated lands in Colorado in the vicinity of Julesburg. The lands under the system have adequate water most years; however, a few landowners have drilled shallow wells into the valley alluvium to supplement surface water.

The flood plain adjacent to the South Platte River has a high water table (four to five feet) which limits production of irrigated crops. Surface drainage is impractical to lower the water table because of the flat gradient of land adjacent to the river in this vicinity.

## Watershed Resources

Wells serve the needs for rural, domestic, municipal and industrial uses in the vicinity.

The only known commercial mineral deposits occurring in the watershed are sand, gravel, and natural gas.

Agriculture is the major industry of the watershed. Operating units in the upper portion are primarily combination ranching and non-irrigated wheat operations. The lower lying irrigated land produces sugar beets, corn, beans, and alfalfa. Most of the corn and alfalfa is fed on the farms through feedlot operations.

The Great Western Sugar Company has a million dollar factory for processing sugar beets at Ovid, Colorado.

Land use in the watershed is shown on the following table:

---

### Land Use

<u>Item</u>	<u>Colorado</u>	<u>Nebraska</u>	<u>Total</u>	<u>Sq. Mi.</u>	<u>Percent</u>
Cropland					
Irrigated	12,135	640	12,775	20.0	19.1
Nonirrigated	4,005	23,535	27,540	43.0	41.3
Range					
Rangeland	13,699 *	10,380	24,079	37.6	36.1
Miscellaneous	1,870	450	2,320	3.6	3.5
TOTAL	31,709	35,005	66,714	104.2	100.0

\*Includes 3,330 acres of saltgrass meadow.

---

The rangeland of the watershed occupies part of the upper areas of the project above the Highline irrigation canal which crosses from the west boundary to the east boundary. These are the tablelands along the Nebraska line and the gravel breaks and outwash areas below the tablelands.

Rangelands above the breaks are closely associated with nonirrigated cropland. The latter makes up the dominant land use in the Nebraska portion of the watershed.

The range sites of these lands include Loamy Plains, Loamy Slopes, Sandy Plains, Gravel Breaks, Shallow Siltstone and Overflow. All the range-land is in good to excellent range condition. The vegetative cover includes blue grama, western wheatgrass, sideoats grama, little bluestem, needle-and-thread, buffalo grass, three-awn and sand dropseed. A few acres of woodland occur in small scattered stands along drainage slopes, in windbreaks and along the river bottoms. The predominant species are cottonwood, ash, elm, willow, and boxelder. Stands are usually well-stocked and provide livestock shelter and wildlife habitat. The vegetative cover varies from 65 to 80 percent ground cover.

Another area of rangeland occurs on the lowlands in the South Platte River Valley. This land, of a lesser extent in acreage than the above, consists of Salt Meadow and Sandy Meadow range sites. These are intermingled with irrigated crop and hayland.

No Wetlands Types 3, 4, and 5 as described in the U.S. Department of Interior Fish and Wildlife Circular 39, *Wetlands of the United States* will be affected by the project.

#### Economic Data

Land ownership in the watershed consists of private and state owned lands in each state as follows:

Ownership	Colorado Acres	Nebraska Acres	Total Acres
Private	29,089	31,085	60,174
State Lands	2,620	3,920	6,540
Total	31,709	35,005	66,714

Of the state owned lands, about 2,018 acres in Colorado are leased to landowners by the Colorado Board of Land Commissioners and 3,920 acres in Nebraska by the Nebraska Board of Educational Lands and Funds. Principal use of these lands is for livestock grazing.

The remaining state owned lands in Colorado consist of approximately 602 acres of grassland in the 893-acre Sedgwick Bar State Wildlife Area. This preserve is maintained and operated by the Colorado Division of Wildlife.

## Watershed Resources

Agricultural enterprises date back to about 1859 and are the major source of income in the watershed. The landowners and operators are very progressive and have developed a better-than-average farm and ranch economy.

The operating units in the upper portion of the watershed comprise livestock ranching units in conjunction with the production of non-irrigated wheat. The operating units in the lower portion are mostly irrigated with the lower lying saltgrass meadows along the South Platte River being grazed.

There are approximately 174 landowners and 135 operating units in the watershed as shown in the following table:

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### Distribution by States

<u>Item</u>	<u>Colorado</u>	<u>Nebraska</u>	<u>Total</u>
Landowners	91	83	174
Operators	67	68	135

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The average size of the operating units is 450 acres.

The principal crops grown and flood-free yields in the watershed are the same for without- and with-project conditions. The principal crops and yields are as follows:

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<u>Crops</u>	<u>Yield</u>
Alfalfa	5.45 tons
Beets, sugar	22.00 tons
Beans, dry	40.80 Bu.
Corn	110.40 Bu.
Wheat - Summer Fallow	30.00 Bu.
Saltgrass Meadow	3.00 AUM

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Most of the corn and alfalfa is fed on the farms through small feedlot operations. The sugar beets and beans, together with livestock production of beef and a few sheep and hogs, are sold as cash crops.

The current per-acre value for irrigated and urban land is about \$550, nonirrigated cropland \$125 and rangeland \$60. The woodland sites are rated low to medium in potential for commercial tree development. Existing sites have little commercial value.

The watershed lands are accessible to markets in both states. In addition to Interstate Highway 80S, U.S. Highway 138 and State Highway 59, numerous county roads and the Denver branch of the Union Pacific Railroad traverse the watershed. The facilities of the Julesburg Airport, transcontinental buslines, and motor freight lines help provide excellent access to and from the watershed locally, statewide, and nationally.

Commercial development normally associated with a primary cross-country highway and railroad has not taken place with the exception of the Great Western Sugar Company factory at Ovid, Colorado and grain storage elevators and agriculture fertilizer and equipment supply dealers in the nearby towns.

It is expected that the economy of the watershed will remain principally agricultural, with most of the units being family-operated.

In 1970 the total retail sales for Sedgwick County was \$13,619,000. Agriculture was the main source with sales estimated at \$9,559,500.

In 1971 Sedgwick County produced sand and gravel valued at \$305,740 and produced natural gas valued at \$55,930.

The 1970 Sedgwick County employed labor force is estimated at 1,827 which is broken down into the following categories:

<u>Category</u>	<u>Employed Labor</u>		<u>Total</u>	<u>Percent</u>
	<u>Male</u>	<u>Female</u>		
Professional - Managers and Administrators	281	110	391	21.4
Wholesale and Retail	137	100	237	12.9
Services	237	181	418	23.0
Contracts and Construction	128	6	134	7.3
Farmers, Mgrs. & Laborers	374	5	379	20.8
Miscellaneous (under 2%)	196	72	268	14.6
<b>Totals</b>	<b>1,353</b>	<b>474</b>	<b>1,827</b>	<b>100.0</b>

## Watershed Resources

Sedgwick County 1970 income breakdown by annual earnings is as follows:

	1970 (Percent)
\$ 0 - \$2,999	17.4
\$3,000 - 4,999	13.2
\$5,000 - 7,999	28.1
\$8,000 - 9,999	15.0
Over 10,000	26.3

Similarly to most of the rural areas of the United States, the agricultural population is declining as shown by the figures for Sedgwick County, Colorado of 4,242 in 1960 and 3,405 in 1970. This is also representative of the population decline in the Nebraska portion of the watershed.

The Overland Trail Resource Conservation and Development Project Sponsors submitted an application November 2, 1970 which included Logan, Phillips, Sedgwick, Washington and Yuma Counties in Colorado. Morgan County was added to the project area July 29, 1971. The project has not been approved for planning.

The Panhandle Resource Conservation and Development Project is authorized for planning and includes Cheyenne and Deuel Counties in the Nebraska portion of the watershed project.

## Fish and Wildlife Resources

The absence of permanent streams and insufficient water in the watershed tributaries, except during flood periods, precludes stream fishing in the watershed. Due to the unpredictability and location of runoff, as well as existing water rights which must be met by State law, proposed impoundments in the watershed are not deemed suitable for water retention and subsequent management for a warmwater fishery.

Wildlife species in the watershed area that usually occur in huntable numbers include ducks, Canada geese, ring-necked pheasants, mourning dove, bobwhite quail, cottontail rabbit, jackrabbit, deer (mule and white-tailed) and pronghorn (antelope). Fox squirrel and racoon are hunted in the creek and river bottoms.

Some of the more abundant non-game species of wildlife are: coyote, skunk, badger, beaver, mink, muskrat, rodents, reptiles and insects. Bird species include several species of owls, migratory hawks and eagles, and a wide variety of songbirds and shorebirds.

Rare and endangered bird species in the area include the prairie and peregrine falcons, bald eagle and possibly, the greater prairie chicken.

Food and cover requirements of wildlife are met in the watershed area as follows: pronghorn and jackrabbits are dependent on range-land, while pheasants, mourning doves, deer, waterfowl, and cottontail rabbits and bobwhite quail are dependent on irrigated and non-irrigated cropland associated with wooded areas along the South Platte River and Lodgepole Creek for food and cover needs. The South Platte River and the adjacent Julesburg (Jumbo) and Jumbo Annex Reservoirs are important factors in attracting waterfowl to the area.

Waters of the South Platte River, adjacent to the project area, are classified in *Water Quality Standards for Colorado* for suitability as a warmwater fishery and irrigation. At the present time, no appreciable sports fishery exists due to periodic low river flows and pollution levels. Channel catfish and bullheads are occasionally caught. Carp, suckers, chubs and minnows are the most common fish present.

Access on the project area is essentially governed by the landowners. The Colorado Division of Wildlife owns the 893-acre Sedgwick Bar State Wildlife Area. This is open to the public. The Division also owns 1,298 acres of the watershed around Julesburg and Jumbo Annex Reservoirs and leases Julesburg (Jumbo) Reservoir (15.70 acres) for public use.

Huntable wildlife species are presently harvested by a relatively small local population and hunters from outside the area, including the Denver Metropolitan Area. At the present time, game populations are probably under-utilized. However, better roads, more free time, and increasing populations indicate this condition will not exist for long.

Fishing opportunities, according to the *1970 Colorado Comprehensive Outdoor Recreation Plan*, exceed demand and are expected to do so in the foreseeable future.

#### Recreational Resources

Existing public recreation areas in Sedgwick County, as given in *An Appraisal of Outdoor Recreation Potentials in the Five Northeastern Colorado Counties* included several small city parks totaling 39 acres.

## Watershed Resources

The largest public facilities include the 2,868-acre (including water) Julesburg Reservoir which offers water-based recreation as well as fishing and waterfowl hunting and the 893-acre Sedgwick Bar property.

The project area is included in Recreation Region "O" and it is reported in the 1970 *Colorado Comprehensive Outdoor Recreation Plan* that supply exceeds demand for fishing, trailer camping, outdoor game areas, tennis, and golf. Other outdoor recreation activities are in deficient supply according to the report.

Accessibility to public facilities for recreational purposes is good. On private land outdoor recreational activities are pursued at the landowner's pleasure.

## Archeological and Historical Values and Unique Scenic Areas

Jules Bevi's ranch headquarters, established in 1859 on the south side of the South Platte River opposite the mouth of Lodgepole Creek, became an Indian trading post and later served as a stopping point for the Pony Express and travelers on the Oregon Trail. Fort Sedgwick was established in 1864 near Bevi's ranch and also on the south side of the South Platte River.

The town of Julesburg has had four locations, the first two were south of the South Platte and the last two locations have been north of the South Platte and east of Lodgepole Creek.

The Nebraska State Historical Society does not have any archeological or historical sites listed for the Nebraska portion of the watershed. The Colorado State Historical Society does not have any historical sites listed in the watershed.

There are no sites listed in the Federal Register, Department of the Interior, National Park Service, National Register of Historic Places. The University of Colorado Archeological Museum has two archeological site cards on file in their office. One card describes scattered surface Indian campsite evidence in the NW 1/4, Section 36, T12-N, R47-W which is in the watershed. The other card was issued for T44 or T45-W, R12-N, but does not indicate any evidence found.

There are no unique scenic areas within the watershed.

## Soil, Water and Plant Management Status

It is expected that land use in the watershed will remain in agricultural uses with most of the farms and ranches being owner-operated.

The land treatment program in both states is making satisfactory progress toward meeting installation needs of the watershed for land, soil and water conservation measures.

Most of the lands in agricultural production that are subject to flooding have been improved and managed to provide best use of the land for production, leveled and shaped to minimize damage from flooding. None of these are considered marginal. Approximately 25 percent of the committed factors for production are used on these lands.

High water tables in the South Platte River flood plain would not benefit from drainage without channelization of the river. Land-owners are doing more smoothing and planting to adaptive grasses to provide best forage for livestock on these areas.

The project area is served by the Sedgwick County Soil Conservation District in Colorado and the South Platte Natural Resources District which comprises Kimball, Cheyenne and Deuel Counties in Nebraska. The Soil Conservation Service provides technical assistance to these districts. These districts are stressing the importance of watershed land treatment and have been active in watershed planning. They have promoted land and water resource conservation programs with schools, scouting and 4-H groups in and near the watershed. Representatives of each district are becoming involved in land use development planning with the county commissioners and town councils.

There are 157 cooperators receiving assistance through the districts; 153 have basic plans. About 88 percent of the watershed is covered by agreements. An estimated 45 percent of the total land treatment needs have been applied to date with an estimated 24 percent of the irrigated cropland, 40 percent of the nonirrigated cropland, and 62 percent of the rangeland having adequate treatment.

Financial assistance has been provided the landowners through utilization of Rural Environmental Assistance Program, Great Plains Conservation Program and Farmers Home Administration funds.

The few acres of woodland serve a beneficial function in watershed use. These stands should be retained and augmented with additional tree planting in woodlands, shelterbelts, recreation sites, and wildlife development.

The watershed area is now partially protected by rural fire districts. Equipment procurement, fire training, and fire prevention education will continue to be developed by the Nebraska State Extension Forester and the Colorado State Forester, cooperating with the U.S. Forest Service through the going Cooperative Fire Control Program.

## WATER AND RELATED LAND RESOURCE PROBLEMS

Damage from floodwater, erosion and sediment runoff is the major problem in the watershed. Primary causes for these damages are the high intensity, short duration summer thunderstorms which occur principally over relatively small areas east of the Rocky Mountains in Colorado.

A considerable portion of the damage is related to the fact that the Highline Canal receives all of the floodwater and sediment originating above it. This results in sediment deposition in the canal system and overtopping of the canal with frequent breaching which, in turn, has caused flooding, erosion and deposition of sediment on the irrigated lands below the canal.

### Land Treatment

There are no areas of critical erosion in the watershed. Minor annual erosion is occurring from sheet and rill erosion on the nonirrigated croplands. Erosion rate is low on the rangeland. Plant cover varies from 65 to 80 percent. There are no noticeable changes in the plant communities. Erosion occurs on cropland from flood flows principally when land is in the row crop rotation.

The soils are mainly deep or moderately deep loams or sandy loams with high or moderately high fertility resulting in good soil-water relationship.

Land use adjustments have taken place on the nonirrigated cropland through the Soil Bank and the Great Plains programs. Minor adjustments need to be made on the irrigated land.

Flooding from upper stream channels frequently overtopped the canal banks and caused erosion and sediment deposition on cropland below. This resulted in farmers taking 900 acres out of the irrigated crop rotation and leaving in a soil protective cover to reduce damages. This land needs to be returned to the cropping system to enable a more efficient use of committed factors of production.

Net returns to the farm and ranching units are comparatively high. This is reflected in the number of landowners and operators cooperating with the districts and the amount of land treatment applied and being applied throughout the watershed.

Some farms would benefit from windbreak, pond, or wildlife plantings. Properly planned and placed, plantings would add materially to the value of these farms and ranches. Some windbreaks are in need of renovation.

## Problems

With continuing good economic conditions, the landowners and operators will have financial ability to install needed project land treatment measures.

Fires destroy grass and tree cover needed for watershed protection. The watershed is protected by rural fire districts developed through the efforts of the Colorado State Forester and the Nebraska State Extension Forester, cooperating with the U.S. Forest Service, through the going Cooperative Fire Control Program. Adequate watershed fire protection can be achieved in Nebraska through this program without program acceleration. In Colorado, accelerated P.L. 566 technical assistance to the Sedgwick and Ovid Volunteer Fire Departments will be needed to help meet state fire loss goals and improve their capability to respond to emergencies. Three additional vehicles and better facilities to house equipment are needed to provide the desired level of fire protection.

### Floodwater Damage

High intensity rainfall produces runoff on the upper part of the watershed. In the middle and lower portion of the watershed, irrigation canals, irrigated farms, county, state and federal roads and the Union Pacific Railroad have been constructed across the drainages.

In the upland areas of Colorado and Nebraska, little damage occurs to the rangeland. There is some damage to the wheatland from sheet and rill erosion. Type and extent of damage depends on time of flooding as most of the wheat crop is harvested by the middle of July allowing high losses by lodging and/or washing out of plants by storms in May, June and July.

The Highline Canal and its lateral and, to a lesser extent, the Petersen and Settlers Ditches all intercept floodwater and sediment flows originating on the lands above each. Floodwater overtops the canal banks with frequent breaching which causes interruption of water delivery to Colorado and Nebraska crops. Breaching of a canal causes more damage to the cropland and crops than overtopping because of the concentration and increase of amount and velocity of flow as the breach deepens and starts draining the canal.

The following photographs show examples of crops that have been washed out by rilling and eroding of land from excess concentration of flows, or covered by sediment on the gentler slopes.



1. Erosion in corn row on Reese Farm from storm runoff in July 1964.

SCS PHOTO 10-9617-6



2. Erosion across beet rows on Jenik Farm from storm runoff in June 1965.

SCS PHOTO





3. Six inches of sediment deposit on sugar beets and two feet of erosion along row from storm runoff in June 1965.

SCS PHOTO



4. Sediment and debris across sugar beet field below break in Highline Canal—storm of August 1968.

SCS PHOTO





5. Debris against corn on Inouye Farm from storm runoff in June 1965.

SCS PHOTO



6. Storm runoff in August 1968 caused overflow adjacent to bridge on Highway 138 requiring extensive backfill to support concrete highway slab.

SCS PHOTO 10-P711-3



Rather than leave numerous channels across the irrigated land, from long experience farmers have leveled and are farming these areas, spreading floodflows over a wider area with shallower depths. Crop rotations aid by having alfalfa as an erosion-resistant crop.

Flooding also occurs to the town of Ovid and the farmsteads, roads, and railroad in the lower flatter portion of the flood plain in Nebraska and Colorado.

Approximately 6,785 acres in the following land uses are subject to flooding from the 100-year frequency storm event:

1. Nonirrigated cropland in wheat-fallow rotation above the irrigated land consists of about 93 acres in Colorado, and about 500 acres in Nebraska in nine ownerships.
2. Irrigated cropland with major crops of alfalfa, sugar beets, beans, and corn consist of about 4,200 acres in Colorado and 200 acres in Nebraska in 53 ownerships. The upper portions of this land between the Highline Canal and the Settlers Ditch averages a 1.6 percent slope. The portion below the Settlers and the Petersen Ditches is on about a 0.5 percent slope to the South Platte River.
3. Row crops in particular are severely damaged or lost from flooding. Of about 900 acres of the irrigated land subject to more frequent flooding, 650 acres are kept in protective soil-cover crops to reduce damage from erosion. The remaining 250 acres are left as idle land. These acres can, with protection, be farmed intensively with higher income-producing row crops in the rotation.
4. Minor flood damage occurs to 770 acres of native pasture and saltgrass meadow in the lower part of the watershed. However, the quality and quantity of forage produced is reduced somewhat by sediment.
5. About 154 acres of miscellaneous uses are subject to flood damage. Topping of roads, highways and the railroad by floodwaters has interrupted service occasionally for short periods of time due to high water, erosion of road surfaces and shoulders, or undermining of road surfaces and bridge approaches. Photograph 6 shows undermining of pavement and erosion of road subgrade by overflow which occurred in 1968. Any interruption of service is detrimental to the agricultural and commercial activities of the service area and to the state and national businesses dependent on these facilities.

## Problems

6. About 49 acres in and adjacent to the town of Ovid are subject to overflow damages. Of these, about 30 acres in the southwestern part of Ovid include 20 residences, one grain elevator, one railroad bridge, one street bridge, 1300 feet of railroad track and 3000 feet of town streets that have been damaged by flooding and sedimentation.

Damaging floods occurred in 1935, 1947, 1948, 1960, 1963, 1964, 1965, 1966 and 1968. Local residents estimate that many other smaller flood flows have occurred but dates and damages are not recalled. Under present conditions, it is estimated that damage commences with the two-year frequency storm event with most flooding occurring from May to September.

The floods of 1935 and 1965 are the largest storms recalled. The June 1965 storm is believed to have caused the greatest amount of damage throughout the watershed. This storm is estimated to have been of greater volume and peak flow than a 100-year frequency storm. Records from the June 1965 storm indicate the following:

1. Damages occurred to 1,800 acres of dry cropland and 4,400 acres of irrigated cropland. Three county bridges were destroyed and six damaged. Nine miles of county road and one state highway bridge were damaged. In Deuel County, several motor vehicles were damaged and personal injuries caused from accidents at washed-out or damaged bridges. The road and bridge damages are estimated at \$17,000. The Union Pacific Railroad reported \$2,600 as the repair cost for roadbed damage.
2. The Julesburg Irrigation District estimated damages to the canal system from 13 canal breaks and silt and debris at \$28,000. Not evaluated was interruption of water service to the farms for nearly a month, because a few rains following the storm prevented additional crop damage to that already suffered. Irrigated crops were destroyed on more than 1,500 acres and damaged on about 2,900 acres. Nine farm houses were flooded, 24 farmsteads flooded, and 3.5 miles of fence damaged.
3. In Ovid, 17 homes were flooded with a few basements and contents suffering high damages. Floors, carpets and furniture were damaged requiring cleanup, repainting or replacement. The grain elevator company estimated \$6,700 damage to facilities and stored grain. The fertilizer company received damages estimated at \$10,000. The damages to residences and businesses are estimated at \$20,000.

4. Following the 1965 storm, the Agricultural Stabilization and Conservation Service office received applications for payments for emergency (F-4) assistance in the amount of \$67,100 for land leveling, debris removal, irrigation ditch repair, grading, shaping, and fencing. This represented 80 percent of the estimated cost. The estimated total cost amounts to nearly \$84,000. In addition, it is estimated that no applications were made on at least \$20,000 of damage repairs. From these applications and damage schedules taken, the land damages from sediment and erosion are estimated at \$104,000.
5. The crop losses from flood damage schedules are estimated at \$267,000 and other agricultural farm damages are estimated at \$62,000.
6. Total damages for the watershed area from the 1965 storm are estimated at \$500,800. Secondary and indirect damages were not estimated for this flood.

Under present conditions damages begin at the two-year frequency. The estimated average annual floodwater damages for the watershed are (Table 5):

1. Agricultural: \$147,320, of which \$136,680 is crop and pasture and \$10,640 is other agricultural damage; and
2. Nonagricultural: \$9,750, of which \$5,730 is to Julesburg Irrigation District; \$2,400 to roads, bridges and railroad; and \$1,620 to the town of Ovid.

The larger floods have caused a number of people to move out of their homes temporarily, particularly in the town of Ovid.

#### Erosion Damage

Erosion rates for the watershed are generally low. There are no areas of critical sediment source. Minor erosion in several natural channels above the Highline Canal occur on nonirrigated cropland. Minor erosion occurs in Nebraska originating where natural channels enter on nonirrigated cropland and flow onto the steeper irrigated cropland above Lodgepole Creek.

The source of sediment above the floodwater retarding structures is mainly from sheet and rill erosion with about 10 percent being produced by gully and streambank erosion. Gross erosion rates from sheet and rill erosion in the watershed average about 0.8 tons per acre on the rangeland and vary from 2.2 to 3.5 tons per acre on dry cropland.

## Problems

Flood plain scour damages on 273 acres are concurrent with flood-flows, particularly on the irrigated cropland while in row crop rotation and to the irrigation systems. Estimated average annual damage from flood plain scour is \$4,750 (Table 5). This has an effect on the quality and quantity of agricultural crops damaged and reduces fertility of agricultural lands.

### Sediment Damage

Principal source of sediment is sheet and rill erosion. Sediment deposition occurs on 377 acres of flood plain lands necessitating cleaning of sections of canals and ditches to maintain operating efficiency after each floodflow and the releveling of affected cropland.

Water quality and sediment yield to the river system downstream is not a significant problem because stream channels have been largely eliminated by agricultural measures, and most of the sediment is deposited near the source.

Average annual sediment damage is estimated at \$6,620 for the watershed (Table 5).

### Drainage

Drainage is not a major problem in this watershed. A few small scattered areas of cropland have been drained on an individual basis. The saltgrass meadows in the flood plain area near the South Platte River are affected by a high water table because of the flat grade of the South Platte River. Drainage is not feasible without channelization of the South Platte River. Landowners have upgraded vegetative cover and operate it under proper grazing use.

### Irrigation

Most of the irrigation water used in this watershed is supplied by direct diversion and by water storage through the Julesburg Irrigation District system. The Julesburg Reservoir, an off-stream site, has lost considerable capacity through sedimentation by long-term diversion of flood flows from the South Platte River. The Julesburg Irrigation District is interested in repair and enlargement of its embankments to insure stability of the structures and a larger capacity for storing over 25,000 acre-feet for regular and late season water. The Highline Canal, Settlers and Petersen Ditches have some problems of seepage losses. To the extent of their capacities, they also intercept and carry floodwater and sediment from the area above each of the canals. Any excess water will cause damages by overflow to the canals, structures, crops, lands and improvements below.

Irrigation water supply to the individual user is not a problem as direct diversion, existing storage, and supplemental water from individually-owned wells provide an adequate water supply.

### Municipal and Industrial Water

There is no problem regarding municipal and industrial water supplies. Water quality and amount of supplies from wells are adequate for the foreseeable needs of the watershed.

### Recreation

Flood waters from the project area have the potential for carrying sediment into the adjacent South Platte River, thus adding to an already heavy sediment load. The sediment load plus additional pollutants preclude use of the South Platte for many recreational activities. No apparent problems, except seasonal drawdowns, have been recognized on Julesburg Reservoir.

Floods during nesting season can cause loss of quail, pheasant, water-fowl, and rabbit nests. Flooding can also cause losses of young wildlife and subsequent reduction of local wildlife hunting populations.

Existing outdoor recreational resources are in two categories, public and private. Access to the public areas is good, while access to private lands requires consent of the operator in both states.

Local population is declining; but the population within the sphere of use, including much of the Colorado Front Range Corridor, is increasing.

There has been no local interest in developing additional recreational facilities within the watershed area. Currently, as reported in the 1970 *Colorado Comprehensive Outdoor Recreation Plan*, supply exceeds the need in several outdoor recreational activities including fishing, trailer camping, outdoor games, tennis, and golf. Water-related recreational activities indicate an immediate need for facilities for swimming and boating.

### Fish and Wildlife

As discussed under Recreation, flood losses, especially during the nesting season, can cause depletion of wildlife population. The impact caused by flood-carried sediment from the watershed area is unknown, but the addition contributes very little to the already heavy sediment load in the South Platte which presently degrades the river for many uses. Currently the river fishery is not important as a source although channel catfish and bullheads are occasionally caught.

## Problems

The State's Comprehensive Recreation Plan indicates there now exists an excess of fishing opportunities in the vicinity of the watershed. According to the comprehensive plan, hunting opportunities are needed, and this need will increase. At the present time, there is a need for 238,000 additional activity days for hunting (especially small game), and this need will increase to almost 367,000 days by 1980.

There is an apparent need for hunting opportunities which can be assisted by development of wildlife habitat, but there is no apparent need for fishing areas.

Endangered bird species in the project area include the prairie and peregrine falcons, bald eagles and possibly the greater prairie chicken.

### Economic and Social

Sedgwick County and the watershed are characterized by relatively high out-migration, comparatively high farm level of living, and low employment in manufacturing or basic industries other than farming. The Great Western Sugar Factory, American Fertilizer and Chemical Company mixing plant and farmers' grain elevators located in the watershed provide mostly seasonal jobs.

The U.S. Census shows peak population for Sedgwick County was 5,580 people in 1930. Population declined slowly to 5,095 in 1950, then dropped more rapidly to 4,024 in 1960 and to 3,405 in 1970. The county population dropped 19.7 percent from 1960 through 1970, and the population of the two towns in the watershed - Sedgwick and Ovid - dropped 30.4 and 18.9 percent, respectively, during this period.

Unemployment for Sedgwick County is 2.4 percent for the civilian labor force. Families earning less than poverty level comprise 13.5 percent and those earning \$15,000 or more 17.9 percent (1970 census). 1970 census averages for the state show unemployment to be 4.2 percent of the available civilian labor force; families earling less than poverty level, 9.1 percent, and for those earning more than \$15,000, 19.7 percent.

The above differences reflect the problems of lack of opportunity for employment in the rural non-farm and farm areas and the lower income available to workers. This is reflected in the present trend to larger and fewer farm and ranch units together with mechanization further reducing employment opportunities.

As a result of these trends, the greatest proportion of emigrants are the young people who are entering colleges or are going to the cities to find economic opportunities. There is a need for additional employment opportunities and for rural community development in and adjacent

to the watershed to keep more of the younger labor force in the area. About 50 percent of the farms in the problem area use one and one-half or more man-years of hired labor as contrasted to family labor.

Other

There are no water management needs in regard to rural, domestic, municipal and industrial water supplies. Supplies from wells are adequate for the foreseeable needs of the watershed.

Water quality is good from wells and irrigation sources. Quality of surface water does suffer somewhat from suspended sediment following floodflows on crop and pasture lands.

## PROJECTS OF OTHER AGENCIES

There are no proposed or existing water resource development projects that will have a direct relationship to the works of improvement included in the Plan.

## PROJECT FORMULATION

The Sedgwick-Sand Draws Watershed Work Plan has been formulated to meet the objectives desired by the local sponsors which can be developed within the provisions of the P.L. 566 program. The land treatment and structural measures selected for inclusion in the project are those that provide most of the project objectives at the lowest annual cost. The final determination of the combination of measures to be included in the plan was made by the Sponsors and the Service.

Discussions with Irrigation District personnel, farmers and project sponsors indicated that their primary objective is to reduce the frequency and magnitude of flooding damage to the Highline Canal, Settlers and Petersen Ditches, and the lands below. Reducing flooding will lower: (1) frequency of canal service interruption by overtopping and breakage of canal banks, (2) erosion, debris and sediment damages to crops, land, irrigation systems, wildlife habitat, roads, bridges, railroad, farmsteads, and to residences and businesses of Ovid, Colorado; and (3) potential for loss of life. This would provide an opportunity for more intensive land use, reduce operation and maintenance costs and assist in development and stabilization of the economy of the area.

A reconnaissance of the recreational and wildlife conditions and potentials of the watershed was made by the Bureau of Sport Fisheries and Wildlife in cooperation with the Colorado Division of Wildlife and the biologist of the Soil Conservation Service. State Foresters from Colorado and Nebraska examined the watershed area to determine its condition and the need for accelerated treatment during the installation period.

Consideration was given to other water resource plans for this watershed and the adjacent area to assure that the elements of the plan will be compatible with full development of the region as anticipated by river basin studies. This watershed was not specifically delineated in the Missouri River Basin Comprehensive Framework Study. Work Plan data will be used in the Western U.S. Water Plan Study and the Colorado State Water Plan.

As a result of a meeting to review the Preliminary Investigation Report held April 8, 1968 and ensuing activities by project sponsors, the Sedgwick-Sand Draws Watershed Conservancy District was decreed June 24, 1969. A request for planning approval followed September 12, 1969 and authorization for planning December 9, 1969.

## Project Formulation

A public meeting was held with sponsors and local people December 2, 1970 to review draft work plan proposals. This resulted in meetings with various sponsoring organizations on December 16, 1970 and August 26, 1971, to arrive at solutions to floodway design problems.

Letters of Agreement were signed on August 6, 1971 and August 21, 1972, by the Union Pacific Railroad Company to provide the street bridge for the Ovid Floodway.

A Letter of Agreement between sponsors and the Colorado Division of Wildlife for land rights, environmental wildlife aspects agreements for Floodway 1 across Sedgwick Bar State Wildlife Area, are general recommendations for wildlife habitat improvement were incorporated in trip report signed and dated November 8, 1971.

A Letter of Agreement signed February 3, 1972 by four of the principal sponsors for construction and maintenance of the structural works of improvement; Sedgwick-Sand Draws Watershed Conservancy District, Sedgwick County Board of Commissioners, Julesburg Irrigation District and the town of Ovid, detailed responsibilities of each for land rights and operation and maintenance obligations.

## Objectives

The objective of the land treatment measures applied and to be applied on the land is to reduce floodwater and sediment damages about seven percent. The state lands administered by the Colorado Board of Land Commissioners and the Nebraska Board of Educational Lands and Funds have good cover conditions. The Commissioners have assured the project sponsors that through their lessees they will continue to apply and maintain land treatment measures agreed to in conservation plans developed with the assistance of District Boards in each state.

Another goal of the sponsors is to increase the level of application of needed treatment measures on the watershed from about 45 to 77 percent of the estimated needs of the watershed during the project installation period. This is expected to achieve adequate treatment on an additional 20 percent of the cropland and about 25 percent on the rangeland during the project period.

Very few changes are to be expected in the farm and ranching enterprises. With better fire protection and management, an increase in vegetative cover is expected to provide for better utilization of resources and a better economy for the area.

Land treatment measures alone were recognized as not providing damage reduction objectives. The sponsors requested that structural measures also be provided to attain needed reduction of damages.

The area of damage is primarily agricultural. However, since there are the Federal Highway 138 and the Union Pacific Railroad crossing the flatter, lower lying areas of the flood plain and the town of Ovid, consideration was given to classifying the structures according to the potential damage that could occur in case of failure. As a result of these considerations, sponsors have agreed to floodwater retarding structures located above the steeper lands of the irrigated area and the farmsteads, providing up to the 50-year level of protection. This would prevent most of the problems now related to high peak runoff to canals, water courses, and irrigated lands. This will materially reduce sediment and debris damages and related costs. This degree of protection will reduce the chance of loss of irrigation water service due to canal damage from all but the larger, more infrequent storm events.

The level of protection for the lower lying area along Highway 138 where the remaining flood peaks have ample opportunity to spread out and be less damaging, would be reduced to handle the damages from the 5-year storm frequency peak flow runoff produced on the unreservoired area except in the vicinity of Ovid.

A 100-year level of protection will be provided to the town of Ovid. This will reduce damages to residential and commercial property and reduce the possibility of loss of life from storms of greater magnitude.

State Forester's review of the watershed conditions in each state concluded that the on-going programs for forestry were adequate except for a minor amount of tree planting in Nebraska and a modest acceleration of fire control in two rural fire control districts in Colorado.

The reconnaissance by the Bureau of Sport Fisheries and Wildlife, Colorado Division of Wildlife, and the Soil Conservation Service biologist indicated that: (1) the dry nature of the tributaries of the watershed, except during flash floods, and the unavailability of a dependable water supply preclude the establishment of fish pools in the floodwater retarding structures or opportunities for waterfowl hunting, (2) the proposed project would not significantly affect fishery resources; (3) project will have a slight beneficial effect on wildlife resources; and (4) fencing of structures and planting of borrow and construction sites with native plants and grasses suitable for wildlife food and cover will provide additional wildlife benefits as well as erosion control.

### Environmental Considerations

Agreements with sponsoring organizations and the Colorado Division of Wildlife provide that fencing around construction sites will conform to specifications agreeable to the Service and the Division of Wildlife.

## Project Formulation

Seeding of construction and borrow areas to establish vegetative cover will be with plant species for erosion control that will also provide wildlife food and cover. Shelterbelt planting of plants and shrubs to be provided by the Colorado Division of Wildlife, will be planted by sponsors within the fenced area of Floodway 1 across the Sedgwick Bar State Wildlife Area. Where possible, agreements for shelterbelt and windbreak plantings for wildlife food and cover will be developed by wildlife and recreational agencies and the individual landowners in conjunction with their conservation plan.

The accomplishment of the objectives for installation of the land treatment and structural measures, together with the agreements reached for additional areas of wildlife habitat food and cover improvement, will more than offset the temporary detrimental effects construction activities will have on wildlife and its habitat.

Recreational developments and municipal and industrial water supply are not an objective of the sponsors as these are not a primary problem in the area. In addition, there appears to be no opportunity to provide storage for these purposes due to low annual yields from the watershed tributaries.

There are no registered archeological or historical sites that will be affected by the project works of improvement.

Since the Colorado State Historical Society has indicated an interest in designating an area along Lodgepole Creek as a historic Indian Camp District, the Soil Conservation Service will notify the Society: (1) when the work plan is approved, showing proposed construction site locations, (2) when the final construction sites are located, and (3) of dates when construction will begin at each site.

The Secretary of the Interior through the Midwest Archeological Center in Lincoln, Nebraska will be notified at the same time as the Colorado State Historical Society so that any additional archeological studies he deems necessary may be conducted.

There is no displacement of people, businesses, or farm operations that will require relocation assistance as a result of the installation of the planned works of improvement.

## Alternatives

The effect that land treatment measures would have on achieving project objectives was given first consideration. The magnitude of possible floodwater, erosion and sediment damage is such that land treatment measures alone will not achieve the desired level of protection.

Because of the numerous sources of possible runoff located above the irrigated lands, consideration was first given to enlarging the Highline Canal to intercept and then convey flood peaks and sediment to a point at which a floodway channel could take floodwater to the South Platte River. No reservoirs were to be used with this program.

Investigations using weighted peak runoff of 712 c.f.s. per square miles from the 10-year frequency storm with land treatment applied, determined that the Highline Canal capacity would have to be tripled for each square mile of runoff intercepted. The normal operating capacity is about 180 c.f.s. in the western portion of the watershed down to about 25 c.f.s. in the eastern portion at the Nebraska state line. Without reservoirs to reduce peak runoff into the Highline Canal, a floodway would have to be provided to convey runoff to the South Platte River at least every 1-1/2 to 2 miles along the canal.

Estimated costs for these floodways proved to be excessive when consideration was given to: (1) stabilization of steep floodway gradient of 150 feet of fall in 2-1/2 miles; (2) land rights, including relocation assistance for several of the floodway routes, and (3) canal enlargement costs. Therefore, it was determined that project objectives would best be achieved by providing floodwater retardation structures and to select routes for floodways that would not involve unnecessary costs for construction and relocation assistance.

Structural measures believed to meet objectives of the sponsors in Colorado were: a combination of floodwater retarding structures with principal spillway release rates restricted to the safe disposal capacity of the Highline Canal; grade stabilization structures at several channel headcuts above the Highline Canal; drop inlet structures into the canal below each reservoir and floodways to carry the principal spillway releases to the river.

Measures to control damages in the Nebraska portion of the watershed were investigated. Two floodwater retarding structures and an attendant floodway to reduce floodwater, erosion and sediment damages were not economically feasible. The flood plain of the Nebraska portion of the project is separate from that of the Colorado structures.

The desires and needs of the Board of Directors of the Julesburg Irrigation District to repair and enlarge the embankments of the Julesburg Reservoir were discussed with representatives of the U.S. Bureau of Reclamation, state agencies, Julesburg Irrigation District sponsors, and Service personnel. It was decided that the problems of the reservoir should have priority for investigations and funds over those of canal seepage losses and canal structural rehabilitation. However, with the large size of the reservoir (over 25,000 acre-feet), both should be investigated under the provisions of some other authority than P.L. 566.

## Project Formulation

The land treatment and structural measures selected for inclusion in this plan are those that most nearly achieve project objectives.

## WORKS OF IMPROVEMENT TO BE INSTALLED

### Land Treatment

Land treatment measures shown in Table 1 include those which are needed and can be applied during the five-year installation period. These measures will provide watershed protection and project benefits through improved land and cover conditions.

Landowners and operators in the watershed with technical and/or financial assistance from the Sedgwick County Soil Conservation District in Colorado; the South Platte Natural Resources District in Nebraska, the Great Plains Conservation Program and the Rural Environmental Assistance Program have applied land treatment measures listed in Table 1A to reduce runoff and erosion through improved condition of the watershed land.

Conservation and Great Plains Conservation Plans developed by landowners and operators with assistance from the sponsoring districts will designate land treatment measures needed on each farm and ranch unit. Technical assistance is available from the Soil Conservation Service through the districts for these measures. Information and assistance will be provided landowners and operators regarding optimum application of fertilizers and use of pesticides through the Soil Conservation Districts. Technical forestry assistance will be provided to interested landowners by the Nebraska State Extension Forester and/or the Colorado State Forester.

Creation of windbreak and wildlife food and protective plantings will be encouraged on farms and ranches through conservation plans developed and revised with owners and operators, Colorado Division of Wildlife, Soil Conservation Service, Soil Conservation and Natural Resources Districts.

Measures to be applied on the irrigated land include conservation cropping system, crop residue management, irrigation ditch and canal lining, irrigation pipelines, irrigation land leveling, irrigation water management, structures for water control and ponds and shelterbelt plantings.

Measures to be applied on the nonirrigated land include conservation cropping system, crop residue management and terraces. Measures to be applied on rangeland include planned grazing systems, range seeding, windbreak and shelterbelt plantings and ponds.

Floodway 1 between Station 231+20 and the South Platte River crosses the Sedgwick Bar State Wildlife Area. Plantings of switch, alkali sacaton and western wheatgrasses, and of Russian olive, juniper,

## Works of Improvement

skunkbush and sumac shrubs will be made in this area. These grasses and shrubs will be provided by Colorado Division of Wildlife and planted by the Sedgwick-Sand Draws Watershed Conservancy District along the west side of the floodway maintenance roadway. The plantings will be located within the roadway fencing for protection.

The State Forester's report indicates adequate watershed fire protection can be achieved in Nebraska without acceleration. However, in Colorado three additional vehicles and better facilities to house equipment are needed to provide the desired level of fire protection to the Sedgwick and Ovid rural fire districts. Technical assistance will be provided to these districts to develop district fire plans, acquire fire control equipment, train personnel and conduct fire prevention programs. In addition, 40 acres of tree plantings will be established on farms and ranches in the Nebraska portion of the watershed.

Soil surveys have been completed and published for Sedgwick County, Colorado and Deuel County, Nebraska. These soil surveys will be used during conservation planning.

No acceleration of the rates of application of measures or technical assistance is needed for the planning and application of the land treatment measures, except for the fire control intensification estimated at \$1,500 of P.L. 566 funds for Colorado.

There are no areas of critical sediment sources that are required to be treated. These planned measures are expected to achieve adequate treatment on 8,450 acres of cropland and 5,700 acres of range-land during the project installation period.

## Structural Measures

Structural measures shown in Table 2 were selected on the basis of the most effective and economical combination to accomplish the sponsor objectives. Alternative combinations of measures, evaluation units, and levels of protection were investigated during planning. The final determination on the combination of measures to be included in the plan was made by the sponsors with the agreement of the Service.

Project structural measures consist of 10 floodwater retarding structures, three floodways (with 27 grade stabilization structures), three grade stabilization structures, and 10 canal drop inlets. Structures are planned to have a 100-year effective life. Structural data is shown in Tables 3, 3A, 3B and 3C.

Figures 1 and 2 show plans for floodwater retarding structure SS-3. This structure is typical of the 10 floodwater retarding structures. Figures 3 through 7 show profiles of the proposed floodways. Figure 8 shows flood plain damage in vicinity of Ovid, Colorado. The project map shows structure locations and benefitted areas.

There are no displaced persons nor relocation assistance involved in the structural program.

There are no known archeological or historical sites in the proposed construction areas. If evidence is found or presented during construction that any materials exist or may be present, construction will stop until the applicable provisions of P.L. 86-523 and/or P.L. 89-665 have been complied with. Applicable state laws concerning archeological and historical site preservation will also be complied with.

## FLOODWATER RETARDING STRUCTURES

Floodwater retarding structures with the required floodwater and sediment volumes are designed to control approximately 56 percent of the watershed area.

### *Classification, Storage, and Level of Control*

The floodwater retarding structures are class a with floodwater storage for the 50-year frequency storm runoff and have sediment storage for the anticipated 100-year accumulation. A two-stage principal spillway in each dam will provide control of the 37-1/2 year storm through the low stage, and the 50-year frequency storm through the high stage. Total storage of the floodwater retarding structures is 5,731 acre-feet of which 3,961 is for floodwater, and 1,770 is for sediment storage. The structures have no permanent conservation storage. A drawdown tube is provided to drain the sediment pools.

### *Site Geology*

Bedrock underlying all of the sites consists of light brown claystone and siltstone of the Brule formation of Oligocene Age. These materials are firm and relatively impermeable. The bedrock in the valley bottoms at most of the sites is overlain by alluvial deposits generally consisting of silt and clay in the lower part and silty well-graded sand in the upper part. The maximum thickness of these deposits ranges from about 20 feet at the smaller sites to an estimated 50 or 60 feet at the larger sites. At most of the dam sites, bedrock in the abutments is at or within a few feet of the surface. The abutments are mantled

## Works of Improvement

by a few feet of silt and clay which are mainly wind-deposited. At the sites where the depth to bedrock is greater, the abutments are underlain by deposits of firm alluvial clay.

The emergency spillway at all of the sites except SS-4 will be excavated into either claystone and siltstone bedrock or into firm alluvial clay. These materials are resistant to erosion. Structure SS-4 spillway is in silt and sand, and will be covered by a thin layer of clay. Adequate amounts of satisfactory borrow materials, mainly silt and clay with some silty sands, are available from within or adjacent to the reservoir area at all of the sites.

### *Foundation Treatment*

Foundation treatment consists of stripping the ground surface beneath the embankment, and construction of a cutoff core into the alluvium. The core will cut through the silty well-graded sand of the upper part of the alluvium to the less permeable silt and clay of the lower part. Cores are expected to average 10 to 15 feet in depth with 1:1 side slopes. Clearing will be done only where construction necessitates.

### *Embankment*

The embankment for the dams will be zoned fill-section having a center core of impervious material and upstream and downstream zones consisting of the coarse permeable material abundant at the sites. Embankment slopes will be 3:1 upstream and 2.5:1 downstream.

### *Principal Spillway*

Each principal spillway will consist of a standard covered two-stage inlet, a 30-inch diameter reinforced concrete pipe conduit placed on a cradle, and an impact basin outlet. Two floodways (1 and 2) are planned to take the combined maximum low stage release from nine of the floodwater retarding structures to the South Platte River. Discharge from Structure SS-8.5 will be contained by the Highline Canal.

The low stage of the principal spillway is set at the elevation of the 50-year sediment volume with the top of the low stage set at the level of the 37-1/2 year frequency storm runoff volume. A drawdown tube is planned to drain sediment pools so there will be no permanent pool as required by the Colorado State Engineer. The crest of the emergency spillways are set at the 50-year frequency storm runoff volume. To confine the low stage spillway releases to the capacity of each floodway, design requires that the maximum low stage discharge for each structure will be the greater of 15 c.f.s. or the discharge required to release the 37-1/2 year storm runoff storage in 10 days or less.

### *Emergency Spillway*

The emergency spillways will be vegetated earth. They will be excavated into the claystone and siltstone bedrock or firm alluvial clay. The frequency of flow in the spillways is once in 50 years. In order to preserve the natural vegetation in the return areas, no exit channel shaping has been considered.

### *Fencing and Seeding*

The dam emergency spillway and borrow areas will be fenced and vegetated for erosion control. Specifications for fencing will meet those of the Service and the Colorado Division of Wildlife. All areas disturbed during construction will be revegetated. Where available, suitable topsoil will be stripped from site and stockpiled for later seedbed preparation. The earthen area of the emergency spillway and the side slopes will be seeded to a selected mixture of adapted grasses and legumes at the proper seeding time. Prior to seeding, the earthen area of the emergency spillway and the side slopes will be compacted to result in a well-firmed seedbed and fertilized with 20-20-0 at a rate of 300 pounds per acre. If weeds become a problem in competing with the establishment of the planted vegetative cover, they shall be controlled by mowing. The seeded area shall be effectively protected by fencing from livestock grazing, livestock, vehicular or human foot traffic. The area is to be protected from burning. In seasons with good production of hay in the area, hay harvesting will be permitted.

### *Land Rights and Land Use*

Approximately 802 acres are required for the 10 floodwater retarding structure sites. This includes the total area needed for the 10 sites - with emergency spillway, flood pool, and emergency spillway return. Eighty-two of these acres will be acquired for the dam and emergency spillway areas comprising 67 acres of pasture and rangeland, and 15 acres of nonirrigated cropland. The remaining 720 acres are required for the pool areas and emergency spillway returns. Of this 720-acre area, 715 acres are pasture and rangeland and 5 acres are nonirrigated cropland. All the land required is in private ownership except sites for structures SS-1 and SS-4 which are on state land. Improvements that will have to be altered or relocated at the structure sites are windmills on sites SS-2, 3, 5, 7, and 8 and a county road on site SS-3.

## **FLOODWAY STRUCTURES**

The three floodways included in the structural measures are Floodways 1 and 2 connecting the Highline Canal to the South Platte River, and the Ovid Floodway extending from Highway 138 around the southwest side of Ovid, Colorado to the South Platte River.

## Works of Improvement

Floodway 1 follows an existing floodway and irrigation drop ditch between the Highline Canal and Petersen Ditch. A new and/or enlarged floodway outlet from the Petersen Ditch to the South Platte River will be required. Floodway 2 is new and will utilize the borrow ditch along county and state roads where possible.

Floodways use existing railroad and state highway bridges. Three new county road bridges, seven farm bridges and one Ovid street bridge will be required. The town of Ovid will move or relocate city utilities as required for construction of the Ovid Floodway.

All floodways will have maintenance roadways built on one side wherever they are not adjacent to an existing road. Floodway 1 crosses the Sedgwick Bar State Wildlife Area and will have a maintenance road on the west side and a grouted road crossing on the riprap at the lower end of the floodway.

### *Design Capacity*

#### Floodways 1 and 2

The Highline Canal intercepts floodwater runoff from the area above it. During major storm activity, irrigation flows will be shut off at the outlet from the Julesburg Reservoir to vacate canal capacity and make it possible to handle flood inflows.

Floodways 1 and 2 have been provided to convey excess floodwater to the South Platte River. The floodways are located at points along the canal where the sum of the maximum low stage principal spillway flows from a group of the dams reach the safe capacity of the canal. This resulted in Floodway 1 handling the discharge from five of the floodwater retarding structures and Floodway 2 handling the discharge from four of the floodwater retarding structures. Structure SS-8.5 is contained by the Highline Canal.

Above U. S. Highway 138, Floodways 1 and 2 have capacity to carry these low stage release flows. However, peak flows from larger storms occurring between the dams and the Highline Canal may exceed the canal capacity and overflow the canal banks without entering the floodways. Simultaneous high stage principal discharges will also exceed the Highline Canal capacity and overflow the banks.

No appreciable local flow will enter either floodway above Highway 138 except between Stations 26+00 and 53+00 of Floodway 2. Here, local peaks greater than the capacity described above will also overtop the floodway.

Below Highway 138 the floodways have capacity for the flood routed 5-year frequency peak storm runoff.

Ovid Floodway

The Ovid Floodway has a capacity for the 100-year frequency peak storm runoff with the project structures in place (850 c.f.s.).

*Site Geology*

Floodways 1 and 2 will be excavated mostly into older alluvial deposits consisting mainly of firm silty and sandy clays which appear to be stable in the side slopes of existing ditches. In the lower reaches of the floodways, the clays are generally underlain by sandy materials at a depth of five to six feet. Water-table levels in this area are usually at depths of about five feet or greater.

The Ovid Floodway will be excavated mostly in sandy material at depths of 2.5 to 5.5 feet.

*Stabilization*

Floodways 1 and 2 will have the designed grade established and maintained by 27 reinforced concrete drop or chute drop spillways with riprap at the lower ends. All existing drops in Floodway 1 except the recently installed one at Station 28+35 will be replaced. Riprap will be used along the Ovid Floodway at bridge, bend and structure locations for stabilization. One grade stabilizing structure will be required for the Ovid Floodway at Station 52+10.

*Floodway Control Structures*

Drop structures out of the Highline, Settlers and Petersen Ditches will have radial gates to control flows into Floodways 1 and 2. Floodway 1 will have a 10-foot wide radial gate and a 4-foot wide slide gate at the Highline Canal and at the Settlers Ditch, and a 14-foot gate out of the Petersen Ditch. A 12-foot wide radial gate will inlet into Floodway 2 from the Highline Canal and another one will inlet from the Settlers Ditch. These gates are included in floodway costs.

There will be water control checks in the Highline Canal and Settlers Ditch where Floodway 1 intersects and in all three canals where Floodway 2 intersects. These will be stop-log type checks so the canals can be blocked to divert flows into the floodways if considered necessary by the canal personnel. Capacities for these five water control checks (H-1, S-1, H-2, S-2 and P2) are shown in Table 3C.

## Works of Improvement

### *Fencing and Seeding*

Fencing will be a construction cost with specifications satisfactory to the Soil Conservation Service and the Colorado Division of Wildlife. All construction areas of the floodways will be reseeded as a construction cost to reduce erosion and sedimentation in the channels. Grass plantings will be made that are selected for their contribution to erosion control and wildlife habitat food and cover.

### CANAL AND FLOODWAY INLETS

There will be 10 canal inlets into the Highline Canal. These drop structures will be located on the natural waterways below the 10 floodwater retarding structures to prevent headcutting from prolonged principal spillway discharge flows.

Canal inlets on waterways where bedload movement may take place will have crests set to provide a debris basin to prevent sedimentation of the canal.

Capacity of canal inlet is the greater of the high-stage principal spillway flow from the upstream dam or the 10-year frequency peak storm runoff. Larger flows will be passed over earth spillway sections in the collecting dikes and into the canal without damage to the drop structures.

In addition to the above, floodway inlet drops will be constructed to control storm runoff inflows at Station 53+00 of Floodway 2 and Station 52+10 of the Ovid Floodway. Each drop is a part of the floodway structural costs. The floodway inlet drop on Floodway 2 has a 5-year frequency storm capacity. The Ovid Floodway inlet drop has a 100-year frequency storm capacity.

### GRADE STABILIZATION STRUCTURES

There are active headcuts in the natural waterways below SS-2 and SS-6. GS-2.1 and GS-2.2 will be installed below SS-2. Below SS-6 there is one headcut that will be stabilized by structure GS-6.

Capacity of these grade stabilization structures is based on the greater of the local 25-year peak storm runoff or the high stage principal spillway release rate of the upstream floodwater retarding structure. Structures located below SS-2 are controlled by the local flow. The GS-6 structure capacity is controlled by the release rate from SS-6.

#### LAND RIGHTS AND LAND USE

Land rights to be acquired for grade stabilization, canal inlets, and floodways are estimated at 59.30 acres comprising 16.94 acres irrigated cropland, 8.72 acres nonirrigated cropland, 21.65 acres of native pasture and rangeland and 11.99 acres for the county road and borrow pits.

Improvements that will be relocated at structure sites consist of nine power poles; 2,550 linear feet of fence on Floodway 2; and a street bridge and city utilities on the Ovid Floodway.

## EXPLANATION OF INSTALLATION COSTS

The estimated project installation cost is \$3,215,510. This cost is composed of land treatment measures estimated at \$890,450 and structural measures estimated at \$2,325,060. Project installation costs are shown in Table 1.

### Land Treatment Measures

The installation costs of measures to be applied are based on present unit costs for each practice and are estimated at \$890,450 over the five year project period. Landowners and operators will furnish funds and equipment estimated at \$802,450 to apply these measures. Most of the measures are eligible for cost-sharing from funds available under the Great Plains Conservation and other programs. Included in the above, the landowners and operators by agreement with the Colorado Division of Wildlife will create and manage about 514 acres of wildlife habitat management. Five hundred acres will be on farms and ranches and 14 acres along floodways at an estimated cost of \$3,550. Also included is the agreement of the Colorado Division of Wildlife to provide wildlife food and covering plantings estimated at \$500 on five acres of shelterbelt along Floodway 1 crossing the Sedgwick Bar State Wildlife Area and to provide for Wildlife Area Management estimated at \$1,000.

Fire control intensification through the rural fire control districts will amount to \$10,000 in Nebraska and \$21,400 in Colorado. Forty acres of tree plantings estimated at \$4,000 will be done in Nebraska. Funds will be provided by the Nebraska State and Extension Forester and Colorado State Forester in cooperation with U.S. Forest Service under regular continuing program.

Funds for technical assistance are estimated at \$51,100. These funds (\$49,100) will be provided by the Soil Conservation Service to the Sedgwick County Soil Conservation District in Colorado (\$35,000) and to the South Platte Natural Resources District in Nebraska (\$14,100). Funds for technical assistance for fire control and forestry are estimated at \$1,500 in Nebraska and \$500 in Colorado. These funds will be provided through cooperative agreements with the U.S. Forest Service.

In addition, P.L. 566 funds will provide \$1,500 for accelerated technical assistance for fire control intensification in Colorado.

## Installation Costs

### Structural Measures

The estimated project installation cost for structural measures is \$2,325,060 as shown on Tables 1 and 2. This cost includes the estimated costs for construction, engineering, land rights and project administration described as follows:

#### *CONSTRUCTION COSTS*

Project construction costs are estimated to be \$1,653,090. This consists of the engineer's estimate of the contract cost of construction, plus 15 percent for contingencies. Construction costs include the cost of dam; floodway construction; seeding the dams, emergency spillways and borrow areas; and fencing the dams and emergency spillways for protection to insure establishment of vegetative cover. Construction costs also include costs for: floodway gates, canal checks for floodwater control, canal inlets and waterway grade stabilization structures for erosion control; seeding of floodways to establish vegetative cover to reduce erosion and sedimentation of channels. A portion of the lower part of Floodway 1 will be fenced to protect channel and special plantings. The estimated cost is based on construction quantities from preliminary plans and current unit costs for similar work and materials in the locality.

#### *ENGINEERING*

Engineering costs are estimated to be about \$231,430. These costs are estimated to be 14 percent of the construction cost. They are to provide construction surveys, foundation studies, laboratory analysis of materials, structure design, and preparation of construction plans.

#### *LAND RIGHTS*

Land rights to be acquired by the sponsors are estimated to cost \$159,520. This includes the cost of acquiring the land needed for structural measures (\$50,020) and land rights relating to structural measures (\$109,500). Sponsors may acquire land rights by title or easements in perpetuity.

Land costs (\$50,020) include the cost of acquiring the dam site and emergency spillway areas of the floodwater retarding structures (estimated at \$34,180 including surveys and fees of \$3,120). It includes the cost of acquiring the land needed for the construction of the floodways, stabilization structures and canal inlets where it is outside the existing right-of-ways (estimated at \$15,840 including surveys and fees of \$1,535).

Land rights costs of \$109,500 are for:

Modification of improvements costing \$5,290 for raising or modifying six stockwells in the pool areas of the floodwater retarding structures (\$3,000), and re-fencing on Floodway 2 (\$890), and for road relocation at structure SS-3 (\$1,400);

Building roads and bridges, estimated at \$96,710 consisting of: relocating county road at structure SS-3 (\$7,500); a county road culvert below SS-2 (\$800); a culvert on Floodway 2 (\$600); three county road bridges (\$33,000) on Floodway 2; seven farm bridges (\$38,500) on Floodways 1 and 2, and a street bridge over the Ovid Floodway (\$16,310); and

Modification of utilities are estimated at \$7,500. This includes moving nine power poles on Floodway 2 (\$4,500), and modifications of water, gas, and sewer lines across Ovid Floodway (\$3,000).

No relocation assistance is needed for this project.

#### *PROJECT ADMINISTRATION*

Project administration for installation of the project is estimated at \$281,020. Project costs for administrative, supervisory, cartographic, construction layout and inspection services provided by the Soil Conservation Service is estimated to be 16 percent of the construction cost, or \$264,490. Project costs for administrative and supervisory services by the sponsors is estimated to be one percent of the construction cost or \$16,530.

#### Cost Allocation

The entire project structural measures installation cost is allocated to flood prevention. There is no non-project cost associated with the project.

#### Cost Sharing

Installation costs for the project will be shared by the local sponsoring organizations and the federal government under authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Congress, 68 Stat. 666) as amended. P.L. 566 funds will bear all construction and engineering service costs. Other funds will bear the cost of land

## Installation Costs

rights. The Soil Conservation Service and the sponsors will each furnish their portion of the project administration costs.

## Fiscal Year Obligations

The estimated schedule of expenditures over the 5-year installation period is tabulated below by use and source. The proposed schedule of expenditures may be adjusted from year-to-year by mutual agreement between the Soil Conservation Service and the sponsors. Adjustments will be based on fund appropriations and installation progress of project measures shown on Table 1. Table 2 shows the distribution of structural measures cost between P.L. 566 and other funds.

Year	Structural		Land Treatment	
	P.L. 566	Other	P.L. 566	Other
First	\$ 50,000	\$ 50,820	\$ 1,500	\$193,400
Second	955,440	4,985	---	183,280
Third	821,350	27,320	---	197,980
Fourth	272,670	5,840	---	157,880
Fifth	49,550	87,085	---	156,410
Total Project	\$2,149,010	\$176,050	\$1,500	\$888,950

## EFFECTS OF WORKS OF IMPROVEMENT

The combination of land treatment and structural measures installed will reduce floodwater, sediment deposition, wind and water erosion, and will improve wildlife habitat throughout the watershed project resulting in an improved environment and strengthened local and regional economy. Primary effects will accrue to landowners and operators of agricultural lands, to public and private utilities, residential and commercial properties, and to private and public transportation facilities and equipment. Secondary effects will accrue from increased production of farm products, fertilizer plants, seed dealers, fuel dealers, truckers, elevators, labor and others supplying materials and services required in the increased production with project conditions.

### Land Treatment

Installation of the project land treatment measures will increase from 45 to 77 percent the application of the estimated needs within the watershed. This is expected to achieve adequate treatment on an additional 20 percent of the cropland and 25 percent of the rangeland. Land treatment measures installed above the floodwater retarding structures will have mostly onsite effects to nonirrigated cropland, rangeland, and to wildlife habitat. These, together with measures installed on the irrigated land, will reduce floodwater, flood plain scour and erosion, and sediment deposition damage to crops, land and improvements. Effects of applied practices resulting from information provided landowners and operators regarding optimum application of fertilizers and use of pesticides will cause a reduction in the chemical pollution of runoff from agricultural lands entering the South Platte River.

Project average annual damage reduction is estimated to be: floodwater, 5.2 percent; sediment 8.5 percent; and erosion, 8.4 percent.

The watershed area is protected by rural fire protection districts. Equipment procurement, fire training and fire prevention education will be continued. Adequate fire protection will be achieved in Nebraska without program acceleration.

In Colorado the current burn rate is 0.6 percent. The Sedgwick and Ovid Fire Protection Districts are well organized with trained volunteers. Their equipment needs to be updated. The accelerated program of equipment improvement will result in these two districts being more mobile and responsive to emergencies. The Districts expect to achieve the state fire loss goal of 0.1 percent which will be a gain of about 1,600 acres for beneficial use.

## Effects of Works of Improvement

In addition to improving the hydrologic condition of the watershed, the effects of 40 acres of tree plantings on farms and ranches, together with the treatment program under the regular continuing forestry program, will increase the multiple-use benefits for wind protection and wildlife habitat. These effects will provide a potential economic return to the cooperating landowners.

The expected creation of 514 acres of upland wildlife habitat management by the cooperative efforts of the landowners and the Colorado Division of Wildlife will increase area available for wildlife.

### Structural Measures

Project structural measures will be effective in decreasing peak flows, resulting in: (1) reduced areas and depth of floodwater inundation, (2) reduced erosion and sediment transportation, (3) reduced damage to highways, railroad, residential and commercial properties, and (4) reduced damage from canal breaching. Project average annual floodwater damage reduction is estimated to be: agriculture, 66.4 percent; nonagricultural, 71.4 percent; sediment, 54.5 percent; and erosion, 54.3 percent. The resulting effect of these measures will be an improvement in the watershed environment and economy.

### Flood Prevention, Erosion and Sediment

Under present conditions at the town of Ovid, runoff from the one percent chance of occurrence storm is estimated to have a peak flow of 3,200 c.f.s. This runoff will be reduced to the equivalent of a ten percent chance peak flow of 850 c.f.s. with the floodwater retarding structures installed. The Ovid Floodway will be enlarged to contain the 850 c.f.s. flow resulting in no out-of-bank flooding for the 100-year and more frequency runoff events.

The degree of protection and the reduction in area and depth of flooding varies by reaches throughout the watershed for the irrigated and nonirrigated cropland. The irrigated land lies mostly on an alluvial fan or plain with no defined channels. The following table shows the number of acres flooded with and without project conditions and percent reduction by reaches and frequencies. The reaches are shown on the Project Map.

The 1965 storm is the largest recorded in recent years. This storm was estimated to be equal to a one percent chance of occurrence event. It is estimated that the works of improvement planned for the watershed would have reduced the 1965 floodwater damages about 64 percent (\$320,510).

Acres Flooded With and Without Project Conditions for  
Irrigated and Nonirrigated Lands by Reaches and Frequencies  
in Colorado

Reach	100-Year		Percent :		Acres		Percent :		Acres		Percent :	
	Without		With		Without		Reduction:		Without		Reduction:	
	FREQUENCIES											
<b>Above Highline Canal</b>												
1	271	114	57.9	210	87	58.6	190	65	65.8	157	20	87.3
2	377	140	62.9	246	67	72.8	231	43	81.4	203	10	95.1
5	109	34	68.8	62	25	59.7	23	0	100.0	19	0	100.0
6	34	0	100.0	22	0	100.0	20	0	100.0	17	0	100.0
9	122	0	100.0	114	0	100.0	110	0	100.0	97	0	100.0
Total	913	288	68.5	654	179	72.6	574	108	81.2	493	30	93.9
<b>Below Highline Canal 1/</b>												
3	642	396	38.3	450	75	83.4	404	238	41.1	333	213	36.0
4	887	355	60.0	608	258	57.6	540	223	58.7	458	203	55.7
5	405	374	7.7	300	246	18.0	274	164	40.1	159	103	35.2
7	126	86	31.7	120	34	71.7	114	15	86.8	106	4	96.2
8	391	169	56.8	274	128	53.3	235	109	53.6	205	104	49.3
9	1,029	413	59.9	744	282	62.1	647	247	61.8	573	224	60.9
10	791	343	56.6	645	238	63.1	553	215	61.1	483	189	60.9
11	723	354	51.0	533	245	54.0	466	212	54.5	409	182	56.5
13	130	64	50.8	101	42	58.4	92	6	93.5	83	4	95.2
Total	5,124	2,554	50.2	3,775	1,548	59.0	3,325	1,429	57.0	2,809	1,256	55.3
Grand Total	6,037	2,842	42.9	4,429	1,727	61.0	3,899	1,537	60.6	3,302	1,256	62.0

1/ 49 acres benefited by the Ovid Floodway not included.

Land use in the 100-year frequency flood plain estimated at 6,086 acres in Colorado consists of 4,200 acres of irrigated cropland, 913 acres of nonirrigated cropland, 780 acres of saltgrass meadows and pasture, 154 acres of miscellaneous use, and about 30 acres of residential and commercial property in the town of Ovid. The major crops grown in the flood plain with- and without-project conditions include alfalfa, beans (dry), sugar beets, and corn grown mostly for ensilage.

With project condition a shift from 250 acres of idle land and 650 acres now in soil protective crops will be made to higher-valued crops and will be included in the crop rotation. No new land will be brought into crop production and no crops in surplus are grown.

The project measures will eliminate crop losses resulting from delay in irrigation water deliveries caused by floodwater breaching the canals. About 18,924 acres being served by the Highline Canal, Settlers and Petersen Ditches are affected. These crop losses now result from a storm occurring on the average of once in three years to the Highline Canal and Settlers Ditch, and from the once in six years to the Petersen Ditch. The crop losses that will be eliminated are through these acres now having reduced yield and quality of crops.

Erosion rates in the watershed are generally low. Source of sediment above the floodwater retarding sites is mainly from sheet and rill erosion with only about 10 percent of the sediment being produced by gully and streambank erosion. The upland erosion rate will be reduced from 0.37 to 0.34 acre-feet per square mile annually. The flood plain erosion scour damage will be reduced from 250 acres to 148 acres, or 107,600 cubic yards annually. Sediment deposition on the flood plain land will be reduced from 377 acres to 345 acres by land treatment measures and from 345 acres to 140 acres by the structural measures annually. Historically, most of the sediment causing damage has been deposited on lower lying flood plain lands and has little effect on deposition along the South Platte River.

There are approximately 174 farms that will be benefitted from project measures and about 6,086 flood plain acres protected from a storm having a one percent chance of occurrence. About 3,244 acres will have full protection, including 625 acres of nonirrigated cropland; 2,589 acres of irrigated cropland and saltgrass meadow, and 30 acres in the town of Ovid.

Average annual damage reduction for agricultural and nonagricultural items are 71.8 percent and 83.3 percent, respectively.

## Effects of Works of Improvement

The town of Ovid will have complete protection from a storm having a one percent chance of occurrence. The maximum depth of flooding, 3.2 feet covering 30 acres, will be reduced to zero depth and area. Benefitted will be: 20 residences, one grain elevator, one fertilizer plant, 1300 feet of railroad track, one railroad bridge, and 3000 feet of town streets. No additional land is expected to be converted to urban use.

Other beneficiaries from the program effects include the Julesburg Irrigation District, Department of Highways and the Boards of County Commissioners.

The relatively slow release rates of the floodwater retarding structures will have a minor incidental effect towards maintaining the present water table and improving water quality.

## Fish, Wildlife and Recreation

There are no specific recreation or wildlife development measures proposed in the watershed.

No rare or endangered species will be placed in further jeopardy by this project. There may be a temporary disturbance of food and cover.

Effects on wildlife habitat due to the project will be of a temporary nature involving parts of about 60 acres disturbed during project construction. However, there will be beneficial effects throughout the watershed for wildlife habitat, resulting from about 40 acres of tree plantings, reseeding about 200 acres of disturbed areas of construction of structural measures and from creation of wildlife habitat management areas estimated at 514 acres.

The floodway through the Sedgwick Bar State Wildlife Area will provide floodwater protection to wildlife habitat and the planting of shrubs (5 acres) along the floodway road will provide food and cover for wildlife and will improve aesthetic values of the area.

Pollution abatement and reduced sediment loads into the South Platte River will have a beneficial affect on the fishery although upstream uses will continue to dictate the quality of the water.

The project should have little effect upon recreational resources although habitat developments will improve aesthetics.

## Archeological, Historical and Scientific

There are no known archeological, historical or unique scenic sites that will be effected by the project measures. None are listed in the National Historical Register. The project measures, by reducing erosion and flooding, will protect and enhance any sites that may be located in the watershed.

Notification will be given to the National Park Service, Midwest Archeological Center, in order that investigations of construction sites can be made when the work plan is signed, when the final site selections are made, and when construction will begin.

During construction personnel will be alerted to keep agencies informed of any evidence or finds of any significance.

### Economic and Social

The economy of the watershed will improve as a result of the project measures installed. This will occur by increasing farm efficiency through the reduction of floodwater, erosion and sediment deposition damages, delay of irrigation water deliveries, and by restoring about 900 acres of irrigated land into the cropping system. The increased returns to the farming units will increase their need for additional labor. This is expected to result in 12 man-years of employment on the farm and three man-years in the associated industries. The combination of these items will have an effect on the economy throughout the watershed and adjacent trade areas.

The effects of the project construction are expected to result in about 6 man-years of employment annually.

The project is not expected to affect adversely any mineral resources nor will it appreciably hamper future exploitation of such resources.

The expected improvement in the economy of the watershed and trade area will provide more employment in agriculture and businesses serving agriculture and should lower migration from the county to cities.

### Other

There will be about 37 acres of irrigated cropland, 9 acres of nonirrigated cropland and 250 acres of rangeland disturbed while the project measures are being installed. These acres will be replanted to grasses and shrubs to reduce erosion and to provide food and cover for wildlife. In addition, there are 565 surface acres for temporary floodwater storage. This includes 272 surface acres for the 100-year sedimentation accumulation. During construction of the measures, the erosion rate may increase slightly until the disturbed areas are revegetated. All practices and standards to reduce pollution during construction will be required.

Food and cover for wildlife will be reduced during this period. After the construction areas are revegetated, the planted grasses and shrubs will provide more food and cover for wildlife than the areas provided prior to being disturbed.

## PROJECT BENEFITS

### Land Treatment Measures

Average annual flood damage reduction benefits accruing to project land treatment measures are estimated at \$9,440 (Table 6).

Benefits from land treatment measures will be mostly on-site benefits to the land on which they are installed. They will improve the soil and water relationship, improve wildlife food and cover conditions, and reduce runoff, erosion, and sedimentation. Better applications of fertilizer and use of pesticides will reduce amount of pollution in the South Platte River arising from agricultural runoff. Inclusion of 250 acres of idle land and 650 acres of soil protective crops into the crop rotation will provide additional farm income.

Additional forage of about 1,600 acres available to landowners and wildlife are expected from the reduction of the Colorado state burn rate, because of the improved rate of fire control.

Creation of 40 acres of tree plantings and 514 acres of upland wildlife habitat management will be of further benefit to livestock and wildlife of the area.

### Structural Measures

Total average annual benefits of \$187,770 accrue to the structural measures. The average annual flood damage reduction benefits are estimated at \$123,490. Benefits from more intensive land use are estimated to be \$46,470. These benefits will be the result of reducing the flood damages to agricultural land and crops, roads, and bridges, and properties in the town of Ovid.

Local secondary benefits induced by and stemming from the project are estimated to be \$17,810. Benefits from a national viewpoint were not considered pertinent to the economic evaluation and are not included in the benefit-cost analysis (Tables 5 and 6).

### Unevaluated Benefits

Although benefits have not been evaluated, wildlife habitat will be improved by plantings of selected grasses and shrubs to reduce erosion and provide wildlife food and cover at all construction sites and in the Sedgwick Bar State Wildlife Area.

This will provide a more widespread dispersion of wildlife in the watershed and provide better hunting in season.

## Project Benefits

Woodland sites are rated low to medium in potential for commercial tree development. Existing sites have little commercial value. Some improved woodland management could result in greater returns and add to the multiple-use benefits already being derived.

## COMPARISON OF BENEFITS AND COSTS

Estimated average annual benefits accruing to project structural measures will be \$187,770. Estimated average annual costs of these measures will be \$141,160 including operation and maintenance of \$12,675. The ratio of the average annual benefits to costs is 1.3 to 1.0. Without the inclusion of secondary benefits of \$17,810 annually, the ratio of average annual benefits to cost is 1.2 to 1.0. Benefits and costs for structural measures are itemized in Tables 4, 5, and 6.

## PROJECT INSTALLATION

### Installation Responsibilities

The estimated project costs for the installation of the land treatment and structural measures are being assumed by the landowners, the sponsoring local organizations and the Service. A number of state agencies and local organizations are also participating by agreement with the sponsors.

In order to coordinate the installation of land treatment and structural measures in a five-year period as scheduled in the *Fiscal Year Obligations*, page 45, close cooperation and assignment of specific responsibilities is required. The South Platte Natural Resources District in Nebraska and in Colorado, the Sedgwick County Soil Conservation District, Sedgwick-Sand Draws Watershed Conservancy District, Sedgwick County Board of Commissioners, Julesburg Irrigation District, Town Council of Ovid, and the Colorado State Soil Conservation Board are sponsors of the project and signers of the Watershed Work Plan Agreement.

The Colorado Division of Wildlife, the Colorado Board of Land Commissioners, the Nebraska Board of Educational Lands and Funds, the Colorado State Forester and Nebraska State and Extension Forester, and the Colorado Division of Highways are participating as state agencies; and the Union Pacific Railroad and the Highline Rural Electrification Association are participating as local organizations by agreement with the sponsors.

Although the project installation period is five years, the lands for structural measures should be acquired during the first year. Other land rights obligations such as: windmill modification, and road and fence relocations; county and farm bridges, and road culverts; utility modifications and the street bridge in Ovid should be provided following start of construction in which each item is associated.

In the event sponsors cannot obtain land rights by donations or land exchanges, the sponsoring local organizations must have land rights interests to be acquired appraised by a qualified land appraiser before initiation of negotiations. The landowner or his representative must be given every reasonable opportunity to accompany the appraiser during his inspection of the property. The sponsors must then establish the amount they believe to be just compensation for the land rights, but in no case, less than the appraised value. The sponsors will then make a prompt offer in writing to acquire the right and include a statement and summary of the basis for the amount established as just compensation. In the event landowners desire more compensation and negotiations fail, sponsors may then instigate condemnation procedures to acquire the needed land rights.

## Project Installation

The Sedgwick-Sand Draws Watershed Conservancy District, Julesburg Irrigation District, Sedgwick County Board of Commissioners, and the Town Council of Ovid have the Right of Eminent Domain to provide the land rights for the structural works of improvement that will benefit the lands and property of each.

The Colorado State Soil Conservation Board will provide funds for personnel to negotiate for land rights and be the Contracting Local Organization for letting of construction contracts. The Director will be the local representative of the Sponsoring Local Organizations responsible for dealing with the Service and the contractor in the administration, contracting and completion of construction contracts. The above five sponsors, in addition to the Sedgwick County Soil Conservation District, will sign project agreements for construction.

There is no relocation acquisition or assistance involved and no sponsor has been assigned responsibility for relocation advisory assistance.

Responsibilities of each organization in the installation of the project works of improvement are as follows:

*The South Platte Natural Resources District in Nebraska and the Sedgwick County Soil Conservation District in Colorado will:*

1. Provide leadership and guidance in the soil and water program for land and water conservation and pollution control, which will continue the going programs for planning, application and maintenance of land treatment measures to be applied during the five-year installation period, and afterwards, on land owned and leased by the landowners and operators of the watershed.
2. Technical assistance funds for these purposes will amount to an estimated \$14,100 in Nebraska and \$35,000 in Colorado.

*The Sedgwick County Soil Conservation District will also:*

1. Modify six windmills at structural sites estimated to cost \$3,000. Windmills are located in flood pool areas as follows: one each at SS-2,3,5, and 7 and two at SS-8.
2. Sign project agreements for construction.

By agreement with the Districts, the Colorado Board of Land Commissioners and the Nebraska Board of Educational Lands and funds have:

1. Provided District sponsors with a statement that they will grant the necessary permits for lessees to install needed land treatment measures on state land; and will require that lessees of state land maintain installed land treatment measures to assure continued improvement of state land resources.
2. By separate agreement with the Sedgwick-Sand Draws Watershed Conservancy District, the Colorado Board of Land Commissioners has provided land easements for structures SS-1 and SS-4, estimated at \$2,475.

By agreements with the Districts, the Colorado Division of Wildlife will:

1. Work with individual landowners and operators to develop agreements for creation and management of shelterbelt plantings for wildlife food and cover in conjunction with their conservation plan.
2. Select and provide plants and shrubs for planting by the Sedgwick-Sand Draws Watershed Conservancy District in selected areas of the Sedgwick Bar State Wildlife Area along Floodway 1.

By agreement with the Districts and the Service, a Forestry Plan was developed which provides the following:

1. The Colorado State Forester will:
  - a. Provide technical assistance for going programs and help to procure needed fire equipment estimated at \$21,400 for Colorado rural fire protection districts.
2. The Nebraska State and Extension Forester will:
  - a. Provide forestry technical assistance to assist in planting 40 acres of trees estimated to cost \$4,000.
  - b. Provide technical assistance to Nebraska rural fire protection districts for fire control intensification on 20,000 acres estimated to cost \$10,000.

## Project Installation

*The Soil Conservation Service will:*

1. Provide funds for the following at an estimated cost of \$2,150,510:
  - a. Accelerated technical assistance estimated at \$1,500 will be provided to Colorado fire protection districts for fire control intensification on private lands through the Colorado State Forester.
  - b. Furnish funds for engineering services for flood protection structural measures estimated at \$231,430 to prepare final designs, cost estimates, and construction specifications in accord with current national and state construction criteria.
  - c. Provide construction funds for structural measures estimated at \$1,653,090.
  - d. Project administration costs estimated at \$264,490 which include: (a) maintaining close working relations with project sponsors and local state and federal agencies participating in the projects; (b) assisting sponsors by inspecting construction, preparing monthly estimates, and certifying to completion of contracts; and (c) providing assistance and consultation to sponsors in making desirable revisions or amendments to the structural works of improvement.
2. Make required notification of work plan approval to the National Park Service, Midwest Archeological Center.

*The Sedgwick-Sand Draws Watershed Conservancy District will:*

1. Exercise the right of eminent domain, if necessary, to provide their land rights obligations by the end of the first year. These land rights are estimated at \$78,070.
2. During the first year, provide land, surveys, and legal fees for structures SS-1,2,3,4,4.5,5,6,7 and 8 and Floodways 1 and 2 and only surveys and legal fees for structure SS-8.5 and the two natural waterways involving structures GS-2.1, GS-2.2 and GS-6. All are estimated at \$41,215 for lands and \$4,255 for surveys and legal fees.

- a. Lands for structures SS-1 (\$1,245) and SS-4 (\$1,230) by agreement with the Sedgwick-Sand Draws Watershed Conservancy District have been provided by the Colorado State Board of Land Commissioners.
  - b. Land for Floodway 2 across the Sedgwick Bar State Wildlife Area, estimated at \$475 by agreement with the Sedgwick-Sand Draws Watershed Conservancy District, will be provided by the Colorado Division of Wildlife.
  - c. Provide land rights estimated at \$32,600. These consist of two farm bridges (\$11,000) on Floodway 1 and three farm bridges on Floodway 2 (\$16,500); a culvert under the county road for Floodway 2 (\$600), and relocating nine power poles on Floodway 2 (\$4,500). These land rights will be provided as required by the construction program.
    - (1) Responsibility for Floodways 1 and 2 for restoring capacity along and across right-of-ways at Highway 138 and for providing a culvert for Floodway 2 across county road in north borrow pit of Highway 138 by agreement with the Sedgwick-Sand Draws Watershed Conservancy District will be performed by the Colorado Division of Highways.
    - (2) Responsibility for relocating nine power poles along the right-of-way for Floodway 2 by agreement with the Sedgwick-Sand Draws Watershed Conservancy District will be performed by the Highline Rural Electrification Association of Ovid.
  - d. Assist in the planting of five acres of wildlife food and cover along Floodway 2 in the Sedgwick Bar State Wildlife Area as part of land treatment program agreements associated with construction. Responsibility for providing plants and shrubs for this 5-acre planting by agreement with the District will be performed by the Colorado Division of Wildlife.
3. Sign Project Agreement for construction contracts.

*The Sedgwick County Board of Commissioners will:*

1. Exercise the right of eminent domain, if necessary, to provide their land rights obligations as needed. These land rights are estimated at \$43,590 and are part of those associated with structures SS-2 and 3, and Floodways 1 and 2 as follows:

## Project Installation

- a. A culvert under county road below structure SS-2 estimated at \$800.
  - b. Make county road and fence relocation at west end of embankment of structure SS-3 and install necessary road and detour signs, flood depth gages, etc. along county road at SS-3 to detour traffic during periods of flood flows that inundate the road; estimated at \$8,900.
  - c. Make fence changes estimated at \$890 and build three county road bridges across Floodway 2 estimated at \$33,000.
  - d. Provide use of sections of country road borrow pits for part of floodway land needs along Floodway 1, about 4.37 acres; and Floodway 2, about 7.62 acres.
2. Sign Project Agreements for construction contracts.
- The Julesburg Irrigation District will:*
1. Provide their land rights obligations as needed for construction at an estimated cost of \$12,120 consisting of the following:
    - a. During the first year providing land for the 10 canal inlet structures estimated at \$1,020 and \$100 for surveys and legal fees.
    - b. During construction provide two farm bridges for crossing Floodway 2 at the Petersen and Settlers Ditches at \$11,000.
2. Sign Project Agreements for construction contracts.

*The Town of Ovid will:*

1. Provide the needed land rights estimated at \$21,710 for the Ovid Floodway. Estimated costs the first year are \$2,100 for lands, \$300 for surveys and legal fees. Estimated costs as needed by construction are \$3,000 for utility changes, and \$16,310 for restoring the original capacity of the Ovid Floodway under the railroad bridge and installing a new bridge on railroad right-of-way across the Ovid Floodway.
    - a. By agreement with the Town of Ovid, the Union Pacific Railroad will perform the items of work on the railroad right-of-way. Its share of the bridge will be \$10,000 with the ownership remaining with the railroad.
2. Sign Project Agreements for construction contracts.

The Colorado State Soil Conservation Board will:

1. By request of the other sponsors the Colorado State Soil Conservation Board will be the Contracting Local Organization. In addition to the following duties the Board will provide funds estimated at \$17,450 for project administration and acquiring part of land rights:
  - a. As the Contracting Local Organization for the construction of all structural measures, will be responsible for advertising and holding bid openings, letting contracts, inspecting and accepting the completed works of improvement for the Sponsoring Local Organizations.
  - b. Providing a local representative to act as liaison between other sponsoring organizations, the contractor, and the Soil Conservation Service.
  - c. Reviewing and approving the final drawings and specifications before bids are advertised.
  - d. Signing the Project Agreement for each construction contract with other five sponsors.
2. Provide funds for project administration estimated at \$16,420.
3. Acquire land rights during the first year estimated at \$1,030 and consisting of \$720 for structure SS-8.5, (\$250) for grade stabilization structures GS-2.1 and 2.2, and (\$60) for GS-6.
4. Assist the Sedgwick County Soil Conservation District and other sponsors in the fulfillment of their project responsibilities.
5. Notify the State Liaison Officer, State Historical Society when the work plan is approved, when final structure sites are selected, and when construction is to begin.

#### Installation Schedule

The following proposed installation schedules for application of project measures describe the origin and use of the obligations of funds shown in the *Fiscal Year Obligations* table on page 45.

#### LAND TREATMENT MEASURES

Land treatment measures to be installed by the owners and operators during the five-year project period are an integral part of this plan. Agreements for wildlife food and cover shelterbelt plantings will be developed by wildlife and recreational agencies and the individual landowners and operators in conjunction with their conservation plan.

## Project Installation

Forestry land treatment measures will be installed by the landowners and State Foresters. Fire control measures will be installed by rural fire districts through the Cooperative Fire Control Program.

## STRUCTURAL MEASURES

The project structural measures are grouped into five fiscal year units for establishing a schedule and priority for developing designs and plans and letting contracts for construction. The floodwater retarding structures, grade stabilizing structures, canal inlets and floodways are grouped and scheduled as shown below:

		Installation Schedule by Years				
		Installation Stage by Year				
		: Investi- : Let : Complete				
Fiscal Year:	Structures in Unit	: Land Rights : Acquisition	: gation & : Design	: Let	: Contract	: Complete Construction
1	FWRS SS-1, 2, 3 4, & 4.5; C1-1, 2, 3, 4 & 4.5; GS-2.1 and 2.2		1st	1st	2nd	3rd
2	Floodway 1		1st	2nd	2nd	3rd
3	FWRS SS-5, 6, 7 8 & 8.5; C1-5 6, 7, 8, & 8.5 and GS-6		1st	2nd &	3rd	4th
4	Floodway 2		1st	3rd	4th	5th
5	Ovid Floodway		1st	4th	5th	5th

## Federal Assistance

Federal assistance for installing structural measures will be provided under the authorization of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

Federal assistance for the installation of structural measures will be made on the following basis:

1. Land rights will be obtained by the local organizations before structural design and specifications are made for each contract. The Julesburg Irrigation District, the Sedgwick-Sand Draws Watershed Conservancy District, the Sedgwick County Board of Commissioners and the Town Council of Ovid will exercise the power of eminent domain, if necessary, to assure that these requirements are met.

2. Project agreements will be entered into between the sponsors and the Soil Conservation Service outlining the responsibilities that each will assume in connection with and prior to the installation of the works of improvement.
3. Reasonable evidence of conformity to state and federal laws and regulations will be presented.
4. An operation and maintenance agreement will be executed and signed by the Julesburg Irrigation District, Sedgwick-Sand Draws Watershed Conservancy District, Sedgwick County Board of Commissioners, Town Council of Ovid and the Soil Conservation Service to assure continuous functioning of the structural measures for the 100-year project period.
5. Sponsors will accept structures following completion of each contract.

#### Methods of Installation

Structural measures will be constructed under a competitive construction contract.

Construction will be carried out under guidelines of construction management and equipment control that will minimize erosion and pollution and maintain environmental quality during construction. These specific measures will be included in construction drawings and specifications. When special or unforeseen problems involving pollution or evidence of archeological sites arise during construction, appropriate measures will be taken to control them by contract modification.

Structural measures will be constructed following safety and health standards set forth in *Safety and Health Regulations for Construction* published by the Bureau of Reclamation, U.S. Department of the Interior and to conform to all Colorado laws.

All federal and state pollution requirements will be met during and after construction.

## FINANCING PROJECT INSTALLATION

### Land Treatment Measures

Installation costs for project land treatment measures will be installed by funds provided by landowners and operators with any other cost-sharing assistance that may be available from funds of the Great Plains programs and from Colorado Division of Wildlife funds for wildlife food and cover plantings.

The Soil Conservation Service will furnish technical assistance through existing program funds at the current rate. This assistance is available through the Sedgwick County Soil Conservation District in Colorado and the South Platte Natural Resources District in Nebraska.

Installation cost of the fire control and other forestry measures will be borne by landowners and rural fire districts with any other cost-sharing assistance that may be available. The cost of the technical assistance will be provided by the Nebraska State and Extension Forester and Colorado State Forester through the cooperative agreements with the U.S. Forest Service. In Colorado, the technical assistance for fire control intensification will be accelerated by the use of P.L. 566 funds.

### Structural Measures

The Soil Conservation Service and the sponsors will each pay assigned costs for installation of the structural measures using funds made available to each. Specific obligations for structural installation costs are stated in the Project Installation section of the Work Plan.

Project costs for structural measures to be furnished by P.L. 566 funds will be paid with funds appropriated under authority of P.L. 566 (83rd Congress, 68 Stat. 666, as amended). Federal financial participation is contingent on Congressional Committee approval and the availability of federal funds for the P.L. 566 program.

This Work Plan is not a financial document for obligation of federal or other funds. The Project Agreement will establish the obligation of federal and other funds for each contract for structural measures.

The source of other funds to be provided by the various sponsors for the items as set forth in the Project Installation section will be as follows:

## Financing Project Installation

1. Sponsoring Local Organizations that will sign project agreements where they are obligated:
  - a. The Sedgwick County Soil Conservation District will use funds available from investment income and local sources.
  - b. The Sedgwick-Sand Draws Watershed Conservancy District will assess and collect taxes for project obligation from the District area.
  - c. The Sedgwick County Commissioners will use funds from their operation and maintenance budget.
  - d. The Julesburg Irrigation District operates on funds available through annual assessments to members for water delivery and operation and maintenance.
  - e. The Town of Ovid will use funds from sales and property taxes.
  - f. The Colorado State Soil Conservation Board will use funds appropriated to it by the State Legislature for its obligation.
2. Local organizations who will contribute by agreement with one or more of the sponsoring organizations:
  - a. The Union Pacific Railroad Company and the Highline Rural Electric Association will each provide funds through their operations programs.
  - b. The Colorado Division of Highways will use funds from their operation and maintenance budget.
  - c. The Colorado Board of Land Commissioners has the authority to grant land rights for floodwater retarding structures on state lands at the request of project sponsors.
  - d. The Colorado Division of Wildlife operates on funds from license and use fees.

## PROVISION FOR OPERATION AND MAINTENANCE

### Land Treatment Measures

Land treatment measures will be maintained by the landowners or operators of farms on which the measures are installed. Technical assistance from the Soil Conservation Service is available through the Sedgwick County Soil Conservation District in Colorado and the South Platte Natural Resources District in Nebraska.

Technical assistance to landowners and rural fire protection districts for operating and maintaining fire control and forestry measures beyond this installation period will be provided by the Nebraska State Extension Forester and the Colorado State Forester in cooperation with the U.S. Forest Service under regular continuing programs.

The Colorado Division of Wildlife will operate and maintain wildlife food and cover plantings and continue management practices of the Sedgwick Bar State Wildlife Area from funds allocated for this purpose. All maintenance work will be done as soon as it is needed.

### Structural Measures

The project measures have been designed to operate effectively for 100 years with proper maintenance. During this period, it is expected that some damage may occur to the structures from large storms. Repair of these damages and all maintenance of the structures are considered to be operation and maintenance costs.

Copies of the *Colorado Watershed and RC&D Operation and Maintenance Handbook* will be provided to the sponsors. The Handbook will acquaint sponsors with the essentials of operation and maintenance of their projects. The information and suggestions will help each sponsor understand and appreciate their job more fully so that it can be carried out in a timely and more efficient manner.

The structural measures will be operated and maintained by the various sponsoring organizations at an estimated annual cost of \$12,675. This represents material, men and equipment as necessary, to repair, maintain, and assure the continued operation of the structural measures as designed. This does not cover maintenance of existing improvements, canals, and floodways in the watershed that are not project measures.

All operation and maintenance work will be done as soon as it is needed by the following responsible organizations:

The Julesburg Irrigation District will assume operation and maintenance responsibility for the following with an estimated annual cost of \$5,525:

1. Ten canal inlet structures adjacent to the north bank of the Highline Canal. These drop structures are located on the natural drainages below each of the floodwater retarding structures.
2. All gates and structures within the Julesburg irrigation system, including Floodways 1 and 2 from the Highline Canal to the outlets from the Petersen Ditch.
3. The Floodways (spillways) 1 and 2 between the Highline Canal and Petersen Ditch.
4. Endeavor to assist the other sponsors, when deemed practicable by the Board of Directors of the Julesburg Irrigation District, with maintenance, etc. of the 10 floodwater retarding dams and spillways, three grade stabilizing structures, and the remainder of the Floodways 1 and 2 from the Petersen Ditch to the South Platte River, when men, money, and equipment are available as determined by the Julesburg Irrigation District Board. Funds are available through annual assessments paid by District members.

The Sedgwick-Sand Draws Watershed Conservancy District will assume operation and maintenance responsibility for the following with an estimated annual cost of \$6,730:

1. The 10 floodwater retarding dams and spillways, the three grade stabilizing structures, and the sections of Floodways 1 and 2 below the Petersen Ditch to the South Platte River. (The Julesburg Irrigation District and Sedgwick County will make every reasonable effort to assist the Conservancy District with this responsibility as part of their normal program.)
2. The Colorado Division of Highways agreed to the use of the north borrow pit along State Highway 138 for enlargement for Floodway 2. However, if operational experience following construction proves this section of the highway to be more of a particular safety hazard than any other section, the Colorado Division of Highways, assisted by the Conservancy District, will determine the need for a guardrail and the responsibilities for cost-sharing for costs of materials and their placement.

The Sedgwick County Commissioners will assume operation and maintenance responsibilities for the following:

1. Maintain the three county road bridges across Floodway 2 as part of the county road system.
2. Assist other sponsors whenever possible with maintenance needs of the structural programs.

The Town Council of Ovid will assume operation and maintenance responsibility for the following at an estimated annual cost of \$420:

1. The Ovid Floodway with an agreement from the Union Pacific Railroad for the maintenance of their new wagon bridge over the floodway.

An Operation and Maintenance Agreement will be developed and signed by each sponsor and the Soil Conservation Service prior to signing of the Project Agreement for installation of works of improvement and the bid advertisement for each construction contract. Each operation and maintenance agreement will enumerate the particular considerations needed to cover requirements of each group of structures to be contracted. The principal considerations and requirements are discussed in the following paragraphs.

The Ovid Floodway requires no operation procedures. No operation of the floodwater retarding structures is required as they have ungated outlets.

Operation of the project measures will require regulation of the canal and ditch irrigation flows and the opening of the floodway inlet gates when heavy rainstorms occur. Company reservoir releases of irrigation water into the Highline Canal will be reduced to provide canal capacity for the floodwater retarding structure releases. The Floodways 1 and 2 anticipated control gates will be opened and the Highline Canal, Settlers and Petersen Ditches will be checked downstream from the floodway gates so the retarding structure releases will be retained in the floodways for conveyance to the South Platte River.

Maintenance will involve removing debris from the reservoirs and debris and sediment from the floodways, maintaining protective vegetative cover where needed, spraying to control noxious weeds, maintaining channel stability, and keeping all structures in serviceable condition and repair as needed during the lifetime of the structure.

To further assure maintenance and improvement of the existing environment and to provide vector control, the following will be done as regular items of maintenance when need develops, but giving first consideration to wildlife food and cover:

1. Proper drainage behind the floodwater retarding structures to minimize the ponding of water.
2. Periodic removal of vegetation and floatage from shallow inundated areas of the reservoirs.
3. Channeling (interceptor drains) in the event marshy or seepage areas develop below the dams.

The structural works of improvement will be inspected annually before the flood season and after each large storm runoff. For three years after completion of construction, the inspections will be made by representatives of the sponsoring organizations and the Soil Conservation Service. After the third year, the sponsors will continue to make the inspections.

Inspection reports will cover maintenance needed, outline what will be done, and establish a schedule for accomplishing the work promptly. Each inspection report and a record of action will be kept on file by the sponsoring organization with copies provided to the Soil Conservation Service. No federal funds are provided for operation and maintenance of land treatment or structural measures.



## TABLES SECTION

### SEDGWICK-SAND DRAWS WATERSHED

*Sedgwick County, Colorado  
Cheyenne & Deuel Counties, Nebraska*



TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Sedgwick-Sand Draws Watershed, Colorado

and Nebraska

Installation Cost Item	Unit	Number		Estimated Cost (Dollars) 1/										
		Non-Fed. Land	Total	P. L. 566 Funds				Other						
				Non-Federal Land SCS 3/	FS 3/	Total	Non-Federal Land SCS 3/	FS 3/	Total					
<b>LAND TREATMENT</b>														
<b>Land Areas 2/</b>														
Cropland	Acre	8,450	8,450	---	---	---	685,650	---	685,650	685,650	685,650			
Rangeland	Acre	5,700	5,700	---	---	---	116,800	---	116,800	116,800	116,800			
<b>Individual Practices</b>														
Fire Control														
Nebraska	Acre	20,000	20,000	---	---	---	---	10,000	10,000	10,000	10,000			
Colorado	Acre	31,709	31,709	---	---	---	---	21,400	21,400	21,400	21,400			
Tree Planting														
Nebraska	Acre	40	40	---	---	---	---	4,000	4,000	4,000	4,000			
<b>Technical Assistance</b>														
Nebraska		---	---	---	---	---	14,100	1,500 5/	15,600	15,600	15,600			
Colorado		---	---	---	1,500	1,500	35,000	500 6/	35,500	37,000	37,000			
<b>TOTAL LAND TREATMENT</b>	xxxx	xxxxxx	xxxxxx			1,500	1,500	851,550	37,400	888,950	890,450			
<b>STRUCTURAL MEASURES</b>														
<b>Construction</b>														
Floodwater retarding structures	No.	10	10	1,101,780	---	1,101,780	---	---	---	---	1,101,780			
Grade Stabilization structures	No.	13	13	117,370	---	117,370	---	---	---	---	117,370			
Floodways	No.	3	3	---	---	---	---	---	---	---	---			
(M) 4/	Mi.	5.02	5.02	323,015	---	323,015	---	---	---	---	323,015			
(O) 4/	Mi.	2.93	2.93	110,925	---	110,925	---	---	---	---	110,925			
<b>Subtotal - Construction</b>				1,653,090		1,653,090	---	---	---	---	1,653,090			
<b>Engineering Services</b>				231,430		231,430	---	---	---	---	231,430			
<b>Project Administration</b>														
Construction Inspection				125,900		125,900	9,490	---	9,490	135,390	135,390			
Other				138,590		138,590	7,040	---	7,040	145,630	145,630			
<b>Subtotal - Administration</b>				264,490		264,490	16,530	---	16,530	281,020	281,020			
<b>Other Costs</b>														
Land Rights							159,520	---	159,520	159,520	159,520			
<b>TOTAL STRUCTURE MEASURES</b>				2,149,010		2,149,010	176,050	---	176,050	2,325,060	2,325,060			
<b>TOTAL PROJECT</b>				2,149,010	1,500	2,150,510	1,027,600	37,400	1,065,000	3,215,510	3,215,510			

1/ Price Base - 1970 Land treatment, 1972 - Individual Practices and structural costs.

2/ Areas estimated to be adequately treated during project installation period.

3/ Federal Agency responsible for assisting in installation of works of improvement.

4/ Type of channel before project: (M) manmade ditch or previously modified channel; (O) none or practically no defined channel.

5/ Includes \$1250 contributed through going programs and RC&amp;D

6/ Includes \$200 contributed through going programs.

Date: April 1974

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT  
 (at time of Work Plan Preparation)

Sedgwick-Sand Draws Watershed, Colorado  
 and Nebraska

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
<u>Land Treatment</u>			
Soil Conservation Service			
<u>Irrigated Land</u>			
Conservation Cropping System	Acre	9,638	9,638
Crop Residue Use	Acre	8,638	6,479
Irrigation Ditch Lining	L.F.	130,000	195,000
Grass & Legumes in Rotation	Acre	1,800	900
Farmstead & Feedlot Windbreaks	Acre	20	2,000
Pond	No.	5	1,500
Irrigation Pipeline	L.F.	25,656	41,312
Irrigation Water Management	Acre	3,138	6,276
Irrigation Land Leveling	Acre	6,186	498,600
Structure for Water Control	No.	850	42,500
Pasture & Hay Planting	Acre	500	15,000
Irrigation Wells	No.	5	33,750
Irrigation Sprinkler Systems	No.	3	22,000
<u>Non-Irrigated Cropland</u>			
Conservation Cropping System	Acre	18,273	18,273
Crop Residue Use	Acre	17,418	14,564
Terrace, Level	Feet	1,314,421	131,442
Contour Farming	Acre	3,717	8,363
Farmstead & Feedlot Windbreak	Acre	45	2,550
Stripcropping	Acre	554	1,108
Diversions	Feet	4,457	669
Wildlife Habitat Management	Acre	153	7,650
<u>Rangeland</u>			
Range Proper Use	Acre	19,166	19,166
Range Seeding	Acre	100	1,500
Pond	No.	67	46,140
Cropland to Grassland	Acres	325	6,500
<u>Subtotal - Soil Conservation Service</u>			1,132,880
<u>Forest Service</u>			
Tree Planting - Nebraska	Acre	14	1,100
Fire Protection - Nebraska	Acre	35,005 2/	10,000
Fire Protection - Colorado	Acre	31,709	5,000
<u>Subtotal - Forest Service</u>			16,100
<u>TOTAL</u>			1,148,980

1/ Price Base - 1970 Price Level

2/ 20,000 of these acres need additional fire protection

Date: April 1974

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Sedgwick-Sand Draws Watershed, Colorado  
and Nebraska  
(Dollars) 1/

Item	Installation Cost P.L. 566 Funds			Installation Cost Other Funds		Total Installation Cost
	Construction	Engineering	Total P.L. 566	Land Rights	Total Other	
<b>Floodwater Retarding Structures:</b>						
SS-1	62,040	8,690	70,730	1,390	1,390	72,180
SS-2	108,360	15,170	123,530	5,260 3/	5,260	128,790
SS-3	222,000	31,080	253,080	16,760 4/	16,760	269,840
SS-4	61,210	8,570	69,780	1,350	1,350	71,130
SS-4.5	53,980	7,560	61,540	2,150	2,150	63,690
SS-5	108,510	15,190	123,700	3,040 5/	3,040	126,740
SS-6	164,010	22,960	186,970	6,030	6,030	193,000
SS-7	162,000	22,680	184,680	6,170 5/	6,170	190,850
SS-8	107,740	15,080	122,820	3,940 5/	3,940	126,760
SS-8.5	51,930	7,270	59,200	790	790	59,990
<b>Subtotal</b>	<b>1,101,780</b>	<b>154,250</b>	<b>1,256,030</b>	<b>46,880</b>	<b>46,880</b>	<b>1,302,910</b>
<b>Grade Stabilization Structures</b>						
GS-2.1, GS-2.2, GS-6	43,940	6,150	50,090	350	350	50,440
Canal Inlets (10 drops)	73,430	10,280	83,710	1,120	1,120	84,830
<b>Subtotal</b>	<b>117,370</b>	<b>16,430</b>	<b>133,800</b>	<b>1,470</b>	<b>1,470</b>	<b>135,270</b>
<b>Floodways</b>						
#1 - 5+00-115+11(M) 2/ 147+10-250+80(0) 2/	186,730	26,280	213,010	13,575 6/	13,575	226,585
#2 - 19+10-70+29 (0) 2/ 70+29-114+50(M) 2/	34,900 76,025 108,145	4,750 10,640 15,140	39,650 86,665 123,285	2,625 30,050 43,210	2,625 30,050 43,210	42,275 116,715 166,495
Ovid Floodway 47+20-67+30(M) 2/	28,140	3,940	32,080	21,710 9/	21,710	53,790
<b>Subtotal</b>	<b>433,940</b>	<b>60,750</b>	<b>494,690</b>	<b>111,170</b>	<b>111,170</b>	<b>605,860</b>
<b>Subtotal</b>	<b>1,653,090</b>	<b>231,430</b>	<b>1,884,520</b>	<b>159,520 10/</b>	<b>159,520</b>	<b>2,044,040</b>
<b>Project Administration</b>			<b>264,490</b>		<b>16,530</b>	<b>281,020</b>
<b>GRAND TOTAL</b>	<b>1,653,090</b>	<b>231,430</b>	<b>2,149,010</b>	<b>159,520</b>	<b>176,050</b>	<b>2,325,060</b>

1/ Price base, 1972.

2/ Type of floodway before project - (M) man-made ditch or previously modified floodway; (0) - none or practically no defined floodway.

3/ Includes \$800 for road culvert and \$500 for windmill modification.

4/ Includes \$7,500 for road relocation; \$1,400 for road fence change and \$500 for windmill modification.

5/ Includes \$2,000 for windmill modifications (1 @ SS-5, 1 @ SS-7 and 2 @ SS-8).

6/ Includes \$11,000 for 2 farm bridges.

7/ Includes \$22,000 for 2 country road bridges; \$890 for fence removal, and rebuilding; and \$2,000 for moving 4 powerline poles.

8/ Includes \$11,000 for 1 county road bridge; \$27,500 for 5 farm bridges; \$2,500 for moving 5 powerline poles and \$600 for culvert.

9/ Includes \$16,310 for street bridge and \$3,000 for relocation of water, gas and sewer lines under floodway.

10/ Includes \$45,365 for landrights and \$4,655 for surveys and fees.

Date: April 1974

TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY

Sedgwick-Sand Draws Watershed  
Colorado and Nebraska

ITEM	UNIT	Structure Number				
		SS-1	SS-2	SS-3	SS-4	SS-4.5
Class of Structure		(a)	(a)	(a)	(a)	(a)
Drainage Area	Sq. Mi.	1.65	7.36	1.18	1.09	1.07
Curve No. (1-day) (AW 11)		68	69	72	70	69
Tc	Irrs.	1.0	2.3	4.0	0.9	0.9
Elevation Top of Dam	Ft.	3758.1	3794.6	3802.2	3690.1	3726.4
Elevation Crest Emergency Spillway	Ft.	3753.1	3789.6	3796.2	3685.1	3721.4
Elevation Crest High Stage Inlet	Ft.	3752.4	3788.9	3795.0	3684.6	3720.9
Elevation Crest Low Stage Inlet	Ft.	3745.1	3778.4	3778.3	3679.8	3714.4
Maximum height of Dam	Ft.	20.0	30.1	40.8	16.1	20.1
Volume of Fill	Cu. Yds.	47,300	107,400	325,900	43,400	37,000
Foundation	Cu. Yds.	13,100	18,300	24,300	16,500	9,800
Total	Cu. Yds.	60,400	125,700	350,700	59,900	46,800
Total Capacity <sup>1/</sup>	Ac. Ft.	125	636	1774	89	82
Sediment Aerated <sup>100 years</sup>	Ac. Ft.	33	184	547	29	25
Retarding	Ac. Ft.	92	452	1227	60	57
Between high and low stage	Ac. Ft.	94	491	1345	66	62
Surface Area	Acres	10	27	65	11	8
Sediment pool	Acres	21	78	129	22	15
Retarding pool <sup>1/</sup>	Acres				15	38
Principal Spillway						
Rainfall Volume (areal) (1 day)	In.	4.20	4.20	4.07	4.20	4.20
Rainfall Volume (areal) (10 day)	In.	7.30	7.30	7.20	7.30	7.30
Runoff Volume (10 day)	In.	1.84	1.93	1.86	2.03	1.93
Capacity of Low Stage (Max.)	cfs.	15	25	65	15	15
Capacity of High Stage (Max.)	cfs.	45	55	120	30	55
Frequency operation - Emer. Spillway	% chance	2.0	2.0	2.0	2.0	2.0
Size of Conduit	Diam. In.	30	30	30	30	30
Emergency Spillway						
Rainfall Volume (ESII) (areal)	In.	5.07	5.07	4.46	5.07	5.07
Runoff Volume (ESII)	In.	1.93	2.01	1.79	2.09	2.01
Type	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	50	225	255	30	40
Velocity of flow (Ve) <sup>2/</sup>	Ft./Sec.					
Maximum water surface elevation	Ft.	3755.1	3791.6	3798.5	3687.3	3723.4
Freeboard						
Rainfall Volume (FH) (areal)	In.	8.63	8.65	7.60	8.63	8.63
Runoff Volume (FH)	In.	4.77	4.89	4.35	5.01	4.89
Maximum water surface elevation	Ft.	3757.1	3794.6	3802.2	3689.3	3726.2
Capacity Equivalents						
Sediment Volume	In.	0.38	0.47	0.53	0.50	0.44
Retarding Volume	In.	1.04	1.15	1.20	1.03	1.00
<sup>1/</sup> Crest Emergency Spillway						
<sup>2/</sup> Not applicable - exit channels are not shaped.						

Date: April 1 1974

TABLE 3 - STRUCTURAL DATA (Continued)

## STRUCTURES WITH PLANNED STORAGE CAPACITY

Sedgwick-Sand Draws Watershed

Colorado and Nebraska

Item	UNIT	Structure Number			TOTAL
		(a)	(a)	(a)	
Class of Structure	Sq. Mi.				
Drainage Area	Sq. Mi.	11.80	8.00	4.17	0.48
Curve No. (1-day) (AMC II)		74	74	74	74
Tc	Hrs.	3.4	2.5	2.0	1.0
Elevation Top of Dam	Ft.	3753.9	3674.8	3679.4	3659.3
Elevation Crest Emergency Spillway	Ft.	3748.9	3669.8	3674.4	3654.3
Elevation Crest High Stage Inlet	Ft.	3747.8	3669.1	3673.6	3654.0
Elevation Crest Low Stage Inlet	Ft.	3733.4	3656.6	3663.1	3649.4
Maximum Height of Dam	Ft.	35.6	29.6	26.9	17.3
Volume of Fill	Cu. Yds.	200,600	188,000	111,400	36,600
Embankment Foundation	Cu. Yds.	29,400	38,300	25,300	9,900
Total	Cu. Yds.	230,000	226,300	136,700	46,500
Total Capacity <sup>1/</sup>	Ac. Ft.	1234	847	516	51
Sediment Aerated 100 years	Ac. Ft.	353	271	182	25
Retarding	Ac. Ft.	881	576	334	26
Between high and low stage	Ac. Ft.	950	653	386	35
Surface Area	Acres	52	41	32	7
Sediment pool	Acres	113	81	57	11
Retarding pool <sup>1/</sup>	Acres				272
Principal Spillway					565
Rainfall Volume (areal) (1 day)	In.	4.17	4.20	4.20	4.20
Rainfall Volume (areal) (10 day)	In.	7.28	7.30	7.30	7.30
Runoff Volume (10 day)	In.	2.15	2.21	2.28	2.51
Capacity of Low Stage (Max.)	cfs.	50	35	20	15
Capacity of High Stage (Max.)	cfs.	105	65	55	25
Frequency operation - Emer. Spillway	% chance	2.0	2.0	2.0	2.0
Size of Conduit	Dim.: In.	30	30	30	30
Emergency Spillway					
Rainfall Volume (ESH) (areal)	In.	4.92	5.07	5.07	5.07
Runoff Volume (ESH)	In.	2.31	2.43	2.43	2.43
Type	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	300	275	135	20
Velocity of flow (Ve) <sup>2/</sup>	Ft./Sec.				
Maximum water surface elevation	Ft.	3751.2	3672.0	3676.1	3656.3
Freeboard					
Rainfall Volume (FH) (areal)	In.	8.37	8.63	8.63	8.63
Runoff Volume (FH)	In.	5.26	5.50	5.50	5.50
Maximum water surface elevation	Ft.	3753.9	3674.8	3678.4	3658.3
Capacity Equivalents					
Sediment Volume	In.	0.56	0.64	0.82	0.98
Retarding Volume	In.	1.40	1.35	1.50	1.00

<sup>1/</sup> Crest Emergency Spillway<sup>2/</sup> Not applicable - exit channels are not shaped.

Date: April 1974

TABLE 3A - STRUCTURE DATA

## FLOODWAYS

## Sedgwick-Sand Draws Watershed, Colorado and Nebraska

Floodway	Reach	Drainage Area Sq. Mi.	Capacity cfs	Water Surface Elev.	Hydraulic Gradient (ft/ft)	Floodway Dimensions			"n" Value As	Velocities ft./sec	Excavation Cu. Yds.	Type of Work	Before Project Flow 4/	
						Bottom (ft)	Side Slope (%)	Depth (ft)						
Floodway 1	5+00 to 42+90	135	350	3,658.3	.0010	.32	.10	.3.3	.035	.025	2.6	3.2	II M(1910) E	
	42+90 to 71+44	135	150	3,615.5	.0004	12	.04	4.5	1.5	.035	.025	1.8	2.3	II M(1910) E
	71+44 to 115+11	135	150	3,613.0	.0010	14	.10	3.2	2	.035	.025	2.3	3.0	14,500 <u>5/</u> II M(1910) E
	115+11 to 147+30	135	150	3,567.6	.0015	18	.15	2.6	3	.035	.025	2.6	3.1	19,160 I 0 E
	147+30 to 187+30	135	150	3,562.0	.0010	16	.10	3.0	2	.035	.025	2.37	3.0	7,370 I 0 E
	187+30 to 212+80	135	300	3,559.4	.0009	30	.09	3.3	2	.035	.025	2.48	3.1	32,850 I 0 E
	212+80 to 250+80	120	135	3,638.2	.0010	12	.10	3.2	2	.035	.025	2.3	3.0	I 0 E
	250+80 to 19+10 <u>6/</u>	120	135	3,603.2	.0010	12	.10	3.2	2	.035	.025	2.3	3.0	60,617 <u>7/</u> II M(1910) E
	19+10 <u>6/</u> to 70+29	120	135	3,523.7	.0015	14	.15	3.2	3	.035	.025	2.3	3.0	1,960 II M(1910) E
	70+29 to 99+55	850	850	3,524.3	.0011	45	.11	4.6	3	.035	.025	3.3	3.0	13,500 II M(1910) E
	99+55 to 114+50	67+30	200	200	3,523.7	.0015	.1							
Ovid Floodway	47+20 to 52+10 <u>8/</u>													

1/ Drainage area not a consideration for floodway design. Principal spillway discharge is primary factor.

2/ I - Establishment of new channel including necessary stabilization measures; II - Enlargement of existing channel.

3/ M() - Manmade or previously modified channel (approximate construction date); 0 - None or practically no defined channel.

4/ E - Ephemer - flows only during periods of surface runoff, otherwise dry.

5/ Floodway #1 subtotal.

6/ Reach length equals 17,105 feet. Includes station 115+62 behind = 25+72 ahead.

7/ Floodway #2 subtotal.  
8/ 650 cfs enters from side channel at this station.

TABLE 3B - STRUCTURAL DATA  
 FLOODWAY STABILIZATION STRUCTURES  
 Sedgwick-Sand Draws Watershed  
 Colorado and Nebraska

Site No.	Capacity (cfs)	Drop (Feet)	Concrete (Cu. Yds.)	Type of 1/ Structure
Floodway 1				
5+00	350	9	70	CH
13+00	350	6	66	CH
18+00	350	8	68	CH
22+00	350	6	66	CH
40+00	350	8	68	CH
53+00 (Inlet)	100	4	25	SD
73+00	150	6	52	SD & CC
78+00	150	8	51	SD
84+00	150	8	51	SD
95+00	150	10	62	CH
112+00	150	5	38	SD
147+00	150	5	28	CC
Floodway 2				
19+25	135	5	39	SD & CC
26+00	135	5	31	SD
32+00	135	6	33	SD
69+50	135	19	79	CH
74+00	135	7	36	SD
80+00	135	7	36	SD
85+50	135	7	44	SD & CC
94+00	135	6	33	SD
103+00	135	5	31	SD
112+00	135	4	29	SD
25+50 <u>2/</u>	135	4	37	SD & CC
35+00	135	4	29	SD
45+00	135	4	29	SD
55+00	135	4	29	SD
Ovid Floodway				
52+10 (Inlet)	650	5	64	SD

1/ CH - Chute Spillway; SD - Straight Drop; CC - Control Check

2/ Station Equation - 115+62 behind = 25+27 ahead

Note: Drainage area and associated frequency and duration of storm are not principal factors in sizing floodways.

Date: April 1974

TABLE 3C - STRUCTURAL DATA  
 GRADE STABILIZATION AND WATER CONTROL STRUCTURES  
 Sedgwick-Sand Draws Watershed, Colorado  
 and Nebraska

Site No.	Drainage	Design	Drop	Concrete	Type of
	Area	Capacity			Structure 1/
	(Sq.Mi.)	(cfs.)	(Feet)	(Cu. Yds.)	
GS-2.1	0.34	100	12	52	CH
GS-2.2	0.56	120	12	60	CH
GS-6	0.43	105 2/	16	64	CH
<b>Canal Inlets</b>					
CI-1	1.60	177	5	35	SD
CI-2	0.84	93	6	29	SD
CI-3	1.76	160	6	35	SD
CI-4	0.26	30 2/	5	16	SD
CI-4.5	0.89	120	4	29	SD
CI-5	1.19	75	4	26	SD
CI-6	1.39	105 2/	4	26	SD
CI-7	0.43	65 2/	5	20	SD
CI-8	0.14	55 2/	7	25	SD
CI-8.5	0.05	25 2/	5	16	SD
<b>Water Control Checks</b>					
H-1		120	0	19	CC
S-1		80	0	14	CC
H-2		80	0	14	CC
S-2		60	0	9	CC
P-2		180	0	27	CC

1/ CH - Chute Spillway ; SD - Straight Drop ; CC - Control Check.

2/ Maximum principal spillway flow used - exceeds 10-year local peak flow.

Date: April 1974

TABLE 4 - ANNUAL COST

Sedgwick-Sand Draws Watershed, Colorado  
and Nebraska  
(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
1	112,955	12,675	125,630
Project Administration	15,530	---	15,530
GRAND TOTAL	128,485	12,675	141,160

1/ Price Base: Installation and O&M 1972.

2/ 100 years @ 5 1/2 percent interest.

Date: April 1974

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Sedgwick-Sand Draws Watershed  
Colorado and Nebraska

(Dollars) 1/

Item	Estimated Aver. Annual Damages		Damage Reduction Benefits
	Without Project	With Project	
<b>Floodwater</b>			
Crop and Pasture	136,680	37,430	99,250
Other Agricultural	10,640	4,400	6,240
Non-agricultural			
Julesburg Irrigation District	5,730	1,150	4,580
Roads and Bridges	2,400	480	1,920
Town of Ovid 2/	1,620		1,620
Subtotal	157,070	43,460	113,610
<b>Sediment</b>			
Overbank deposition	6,620	2,450	4,170
<b>Erosion</b>			
Floodplain Scour	4,750	1,770	2,980
<b>Indirect</b>			
	16,680	4,510	12,170
<b>TOTAL</b>	<b>185,120</b>	<b>52,190</b>	<b>132,930</b>

1/ Adjusted normalized prices for crop and pasture and current prices for other items.

2/ Damages and benefits will accrue from floods of greater magnitude than the 100-year frequency, but were not evaluated.

Date: April 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Sedgwick-Sand Draws Watershed  
Colorado and Nebraska

(Dollars)

Eval- uation Unit	Average Annual Benefits 1/				Average Annual Cost 3/	Benefit Cost Ratio
	Damage Reduction 2/	More Intensive Land Use	Secon- dary	Total		
1	123,490	46,470	17,810	187,770	125,630	1.5 to 1.0
Project Adminis- tration	---	---	---	---	15,530	--
GRAND TOTAL	123,490	46,470	17,810	187,770	141,160	1.3 to 1.0

1/ Adjusted normalized prices for crop and pasture and current prices for other items.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$9,440.

3/ From Table 4.

Date: April 1974



INVESTIGATIONS AND ANALYSES SECTION

SEDGWICK-SAND DRAWS WATERSHED

*Sedgwick County, Colorado  
Cheyenne & Deuel Counties, Nebraska*



## INVESTIGATIONS AND ANALYSES

### Land Use and Treatment

Land use of the project includes irrigated and nonirrigated cropland, rangeland, saltgrass meadow and land in miscellaneous uses, such as towns, farmsteads, private and public roads, railroad, irrigation canals and ditches, and farm laterals.

Treatment measures were developed by technicians of the Soil Conservation Service and other agencies working with the Districts in each state.

In addition, the landowners and operators by agreement developed by the Colorado Division of Wildlife will create and maintain wildlife upland management areas.

A forestry plan has been developed in each state to provide fire control intensification and tree planting in Nebraska.

Specific measures were selected because of their need and their demonstrated ability to conserve water, protect soil resources, provide wildlife food and cover, control erosion and sedimentation. The measures included in the work plan are those which can be installed within the project five-year installation period.

### Fish, Wildlife and Recreation

An interagency biological reconnaissance was held on the Sedgwick-Sand Draws Watershed Project on October 3 and 4, 1968. Agencies represented were: Bureau of Sport Fisheries and Wildlife, Colorado Division of Wildlife, and the Soil Conservation Service.

The reconnaissance group also considered recreation opportunities for possible inclusion in the project.

A final report on the reconnaissance, dated July 19, 1971 was received from the Bureau of Sport Fisheries and Wildlife with recommendations. Comments and recommendations from the Colorado Division of Wildlife were also received in a letter dated August 18, 1971.

Agreement on agency recommendations was reached at a meeting held in Sedgwick, Colorado on November 8, 1971. An agreement on items was signed at this time by the interested parties and are those set forth in this Work Plan associated with the land treatment and structural measures to be installed.

## Hydrology and Hydraulics Investigations

### HYDROLOGIC PROBLEMS

Floodwater and sediment damages occur in varying degrees on agricultural and commercial areas throughout the watershed. Those damages result from runoff from high intensity thunderstorms occurring on part or all of the watershed, primarily during the period from May through September. According to residents living in or near the watershed, damaging floods occur about every two years.

Over the years all existing stream channels through the irrigated area have been leveled and are now being farmed. Because of this, most any flow can and does cause damages.

### BASIC DATA

Precipitation amounts for floodwater storage and evaluation were determined from revised precipitation frequency maps from the National Weather Service and Weather Bureau Technical Paper No. 49. There are no streamflow records in the watershed and no known slope area measurements have been taken in the watershed.

Detailed soil maps for both the area in Colorado and Nebraska were used to determine the location and type of all soils in the watershed. Soils were classified into hydrologic groups according to procedures of Chapter 7, Section 4, National Engineering Handbook.

Range specialists in Nebraska furnished the soil-cover complex conditions for the Nebraska portion for rangelands, and information furnished by other specialists was used to determine soil-cover complex numbers for the croplands.

Range specialists in Colorado surveyed the existing range condition for the portion of each drainage in Colorado. The soil-cover complex information from Nebraska and Colorado was used to set a composite curve number for each drainage. The soils information and farming methods on the irrigated land below the several structures were used to set a composite curve number for the irrigated land in the Colorado portion of the watershed.

The high waterline for the 1965 storm was surveyed. Cross-section data and the flood data from the 1965 storm were used to determine the area inundated by the various frequency storms.

Twenty-six cross sections were surveyed throughout the flood plain. An additional 18 cross-sections were surveyed between Sedgwick and Ovid to determine the extent of flooding above the dikes formed by the highway and railroad grades. Bridge and channel cross-sections were surveyed in three locations at each bridge to determine the existing capacities of the bridges and channels below the bridge. Water Surface Profile Computer Program was used to obtain rating curves for these cross-sections.

These data were used to prepare the input data sheets for Technical Release No. 20, Project Formulation - Hydrology Computer Program. Only the future conditions with structures was routed to determine the residual flows.

#### LAND TREATMENT

The effects of land treatment measures to be applied on peak rates and volume of runoff were evaluated for each drainage in the watershed. Average effects of these land treatment measures reduced the runoff curve number up to one point in most structure sites. These effects were converted to average annual acres benefitted.

#### HYDROLOGIC DESIGN OF FLOODWATER RETARDING STRUCTURES

All structures in the watershed were classified according to the potential damage that may occur in case of failure. All structures are a classification, but will have floodwater retarding storage equal to a b class structure. The emergency spillways will be designed using the average of a and b class criteria. Rainfall amounts used to determine floodwater retarding storage are listed in Table 3.

Alternatives were considered to exchange floodwater retarding storage in sites with a high cost per acre-foot to sites with less cost per acre-foot, and to maintain a constant combined principal spillway outflow. All structures were considered as interdependent on each other and all were essential to achieve the desired level of protection.

Hydrographs used for design of the emergency spillways, freeboard, and principal spillway design were developed using criteria in Soil Conservation Service Memorandum No. 27 (Revised), and procedures from Chapter 21, Section 4, National Engineering Handbook.

#### FLOOD ROUTING

Flood routing for evaluation was done manually using the procedures from Chapter 17, Section 4, National Engineering Handbook. Each area below a structure(s) was considered as an individual reach

## Investigations & Analyses

and the acres flooded by reach and by frequency were totaled to obtain watershed total by frequency. Routings were made for two frequencies for both present and future conditions. The difference between the present and future acres flooded were the benefitted acres due to structural measures.

Flood routing along U.S. Highway 138 was done by computer to determine the residual flows after project is in place. Flood routing through all structures to size the emergency spillways was done manually using Culp's Graphical Procedure.

### FLOODWAYS

*Ovid Floodway:* Cross-sections were surveyed in Ovid to determine the best location for the flood channel through the southwest part of the town. The rating curves for the planned flood channel were obtained by manually computing the water surface profiles. The floodway through Ovid was designed to contain the residual flow from the 100-year frequency storm with structures in place.

*Floodways 1 and 2* were designed and located at points where the combined maximum low stage principal spillway discharges from five of the floodwater retarding structures approach the safe operating capacity of the Highline Canal. Routing indicates that local inflow will be past by the time maximum structural outflow occurs; therefore, no local inflow was considered in the design of the floodways.

### Engineering Investigations

#### SURVEYS AND DATA USED FOR THIS WORK PLAN

Topographic and centerline profile surveys were made of floodwater retarding structure sites. Profiles and cross-sections were surveyed along the floodway alignments.

Elevations are based on mean sea level taken from USGS 7.5' quadrangle maps.

#### DESIGN AND PROPORTIONING OF STRUCTURES

Structure storage capacity was set to provide the estimated 100-year sediment accumulation at the site plus the 50-year floodwater capacity determined by hydrologic criteria.

Principal spillways for the floodwater retarding structures require two-stage inlets with minimum release rates on the low stage. The Highline Canal has capacity to convey the low stage releases from five of the structures to each of the Floodways (1 and 2).

The high stage inlet was set at the 37.5-year frequency storage requirement. Floodways 1 and 2 are sized to carry the low stage principal spillway releases above Highway 138 and the 5-year peak flow from Highway 138 to the South Platte River. The Ovid Floodway is designed to carry the 100-year peak flow to protect Ovid.

Geological investigations were made for each site. Adequate quality borrow is considered to be available at or near the embankment locations.

Floodways were designed using a velocity of three feet per second and an n-value of 0.025 as limiting controls for as-built conditions.

Borings were made where soil stability was questionable.

### Cost Estimates

#### LAND TREATMENT MEASURES

Estimates of land treatment measure quantities are based on a study of the needs in the watershed. Cost estimates reflect current prices taken from the Rural Environmental Assistance and Great Plains Conservation Programs and other sources of local costs for these types of measures.

#### STRUCTURAL MEASURES

Construction cost estimates for the structures are based on quantities from preliminary designs and current prices from similar work in the locality. A contingency factor of 15 percent was added to the engineer's estimated cost to obtain the construction cost estimates.

Engineering costs are estimated to be 14 percent of the construction cost. Project administration is estimated to cost 17 percent of the construction cost including one percent for sponsor administration of contracts.

Annual operation and maintenance cost for the floodwater retarding structures is estimated to be 0.4 percent of the construction cost. Annual operation and maintenance cost for the floodways and stabilization structures is estimated to be 1.5 percent of the construction cost. Operation and maintenance costs are estimated average annual costs for the structure life.

#### Geologic Investigations

A preliminary geologic investigation was made at each of the 10 floodwater retarding structure sites and along the two floodways. A geologic map was prepared for all but the two smallest floodwater retarding structure sites. Test holes were drilled with a power

## Investigations & Analyses

auger along dam centerlines, in emergency spillway locations and in potential borrow areas at sites SS-2, SS-3, SS-5, SS-6, SS-7, and SS-8. Test holes were drilled with a power auger in emergency spillway locations only at sites SS-4 and SS-4.5. In addition, several test holes were dug with a backhoe along the dam centerline at site SS-3 and along the original centerline at site SS-6. Laboratory tests were made on a soil sample from the proposed borrow area for the SS-3 structure. Data were also available from previous laboratory tests made on soils from the nearly Fort Sedgwick Watershed.

The valley bottoms at most of the sites are underlain by permeable sands over silty clays with the maximum depth to impermeable claystone and siltstone bedrock ranging from about 20 feet to about 40 feet. Relatively impermeable materials lie at shallow depths at most of the sites, and the average depth of cutoff trenches will range from 10 feet to about 15 feet. At all of the larger sites, the emergency spillway will be excavated into relatively resistant alluvial clays or claystone bedrock. Adequate amounts of satisfactory borrow materials are available at all sites.

Detailed geologic investigations will be made at all sites before final design and construction of the dams. Laboratory tests will be made on samples of foundation materials, as well as on any materials to be used in the embankment of the dam.

### Sedimentation Investigations

No previous records of sediment production were available for the area included in the Sedgwick-Sand Draws Watershed. Sedimentation rates at the 10 floodwater retarding structure sites were based on mapping of sediment source areas above the sites, on measurements of streambank and gully erosion, and on reservoir sedimentation surveys of several dry reservoirs in eastern Colorado as well as a sedimentation survey of a small reservoir in the upper part of the watershed in Nebraska.

The land above the sites is largely (about 60 percent) in non-irrigated cropland, much of which is on slopes of less than three percent. The remainder of the land is short-grass rangeland in fair to good condition with some moderate to steep slopes. Erosion rates are generally low. Source of sediment above the sites is mainly from sheet and rill erosion with only about 10 percent of the sediment being produced by gully and streambank erosion.

The average annual sedimentation rates at the sites vary from a low 0.20 acre-foot at SS-1 to a high of 0.52 acre-foot per square mile at SS-8.5. The sediment storage requirement in the reservoir at each site for a 100-year period is 33 acre-feet for SS-1; 184 acre-feet for SS-2; 547 acre-feet for SS-3; 29 acre-feet for SS-4; 25 acre-feet for SS-4.5; 121 acre-feet for SS-5; 353 acre-feet for SS-6; 271 acre-feet for SS-7; 182 acre-feet for SS-8, and 25 acre-feet for SS-8.5. A sediment trap efficiency of 90 percent was used for all structures.

### Economic Investigations

#### FLOODWATER, SEDIMENT AND EROSION DAMAGE APPRAISAL

Basic floodwater, sediment and erosion damage information was obtained by interviewing flood plain operators, Board of County Commissioners of Sedgwick County, Colorado and Deuel County, Nebraska; Julesburg Irrigation District Board of Directors, and residents of homes and managers of commercial establishments in the town of Ovid. Damage information was obtained from the Union Pacific Railroad Company by the Sedgwick County Soil Conservation District. This information together with flood plain surveys and flood routings was used to determine the level of protection that could be provided to best meet objectives of the sponsors.

The frequency method was used to measure floodwater, sediment and erosion damages and damage reduction benefits. This method is described in the *Economic Guide for Watershed Protection and Flood Prevention*, Soil Conservation Service, March 1964.

Preliminary investigations indicated a need for more than one evaluation reach for calculating damages and damage reduction benefits. Two reaches were delineated that reflect differences in the composite acre. One was delineated for Colorado and one for Nebraska.

Estimated costs of structural programs and damage reduction benefits for these reaches were calculated, resulting in a favorable benefit-cost ratio for a structural program in Colorado and an unfavorable benefit-cost ratio for Nebraska.

#### CROP AND PASTURE DAMAGES

Floodwater damage to crops reflects the net loss of income for the series of storms expected to occur in a 100-year period. A composite acre for the agricultural land was developed from interviews and field studies. Crop budgets were developed and used in calculating decreased and increased costs of production resulting from floods.

## Investigations & Analyses

A percent damage loss for each crop was developed considering depth of inundation and month of flooding. These percent losses were used to determine the damage rate for the composite acre. Damage rates developed were weighted by the percent of excessive storms that occur in each month. Damages were expressed in dollars for an average annual composite acre. This was applied to acres flooded by depth and frequency. Damage frequency curves were developed for without- and with-project conditions. The average annual damages were determined from the curves.

### OTHER AGRICULTURAL DAMAGES

Damages in this category include fences, field roads, farm machinery, irrigation equipment and ditches, livestock, and debris cleanup. Damages were calculated from information collected from farm operators.

Damage-frequency curves were developed for without and with project conditions. The average annual damages were determined from the curves.

### NONAGRICULTURAL DAMAGES

Annual damages for roads and bridges and the Julesburg Irrigation District were provided by the Board of County Commissioners and the Board of Directors of the District, respectively. Annual damages to the railroad were developed based on information provided by the Company.

Residential and commercial property in the town of Ovid were numbered and elevations were surveyed. Depth of flooding by frequency was provided by the hydrologist. The value of the property and contents was set by the local people. A damage frequency curve was developed for without and with project conditions. The average annual damage was determined from the curve.

### SEDIMENT AND EROSION DAMAGES

Sediment and erosion damages were calculated from data collected through interviews and four emergency assistance applications made to the Agricultural Stabilization and Conservation Service. Damage-frequency curves were developed for without- and with-project conditions. The average annual damages were determined from the curves.

## INDIRECT DAMAGES

These damages were calculated to be 10 percent of the direct damages for agricultural and 20 percent for nonagricultural.

## MORE INTENSIVE USE

Reduced flooding will result in a change of the cropping system on the flood plain under project conditions. With the flood hazard greatly reduced, low yielding soil protective cover crops will be replaced with the production of sugar beets, beans (dry), and corn silage. The following table lists crops and their acreage with- and without-project conditions:

Crops and Acreage Grown With and Without Project Conditions

Crops	Acres	
	Without Project	With Project
Idle	253	---
Alfalfa	3,513	<u>1/</u> 2,863
Sugar Beets	3,052	3,382
Beans, Dry	2,114	2,342
Corn, Silage	3,203	3,548
Total	12,135	12,135

1/ Includes 650 acres used mostly as a cover crop to protect the soil from floodwater erosion.

Flood-free yields are based upon interviews with farmers, Soil Conservation Service technicians and crop yield predictions by soil series for Major Land Resource Area 67, prepared by the Soil Conservation Service, 1968.

Crop budgets developed for the project were used in calculating decreased and increased cost of production. Variable cost analysis for the cropping system was used in evaluating changes that will be brought about with project condition. Annual costs of associated land treatment measures were deducted from the increased income with project conditions. Increase of floodwater damages to the higher value crops was deducted from the increase in crop return.

### DELAY IN IRRIGATION WATER DELIVERY

Reduced yields and quality of crops result from delays in irrigation water deliveries. Procedure developed by the Portland Engineering and Watershed Planning Unit was used in calculating crop damage. The procedure uses an average gross income per inch of net irrigation water required, resulting in a weighted damage per composite acre per break.

### SECONDARY BENEFITS

These benefits were computed using the two conditions outlined in Chapter 11 of the *Economic Guide for Watershed Protection and Flood Prevention*, March 1964. One effect is the value of local secondary benefits stemming from the project. The value was considered to be 10 percent of the direct primary benefits. Benefits from reduction of indirect damages were excluded in computing stemming from secondary benefits. The second condition is the value of local secondary benefits induced by the project. This value was considered to be 10 percent of the increase in production costs resulting from the project, and 10 percent of the project operation and maintenance cost.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluations.

### PRICES

Adjusted normalized prices as provided in the *Interim Price Standards for Planning and Evaluating Water and Land Resources*, Water Resources Council, dated April 1966 were used in computing crop and pasture damages and damage reduction benefits. Current prices were used for noncrop, project installation, and operation and maintenance costs.

### PERIOD OF EVALUATION

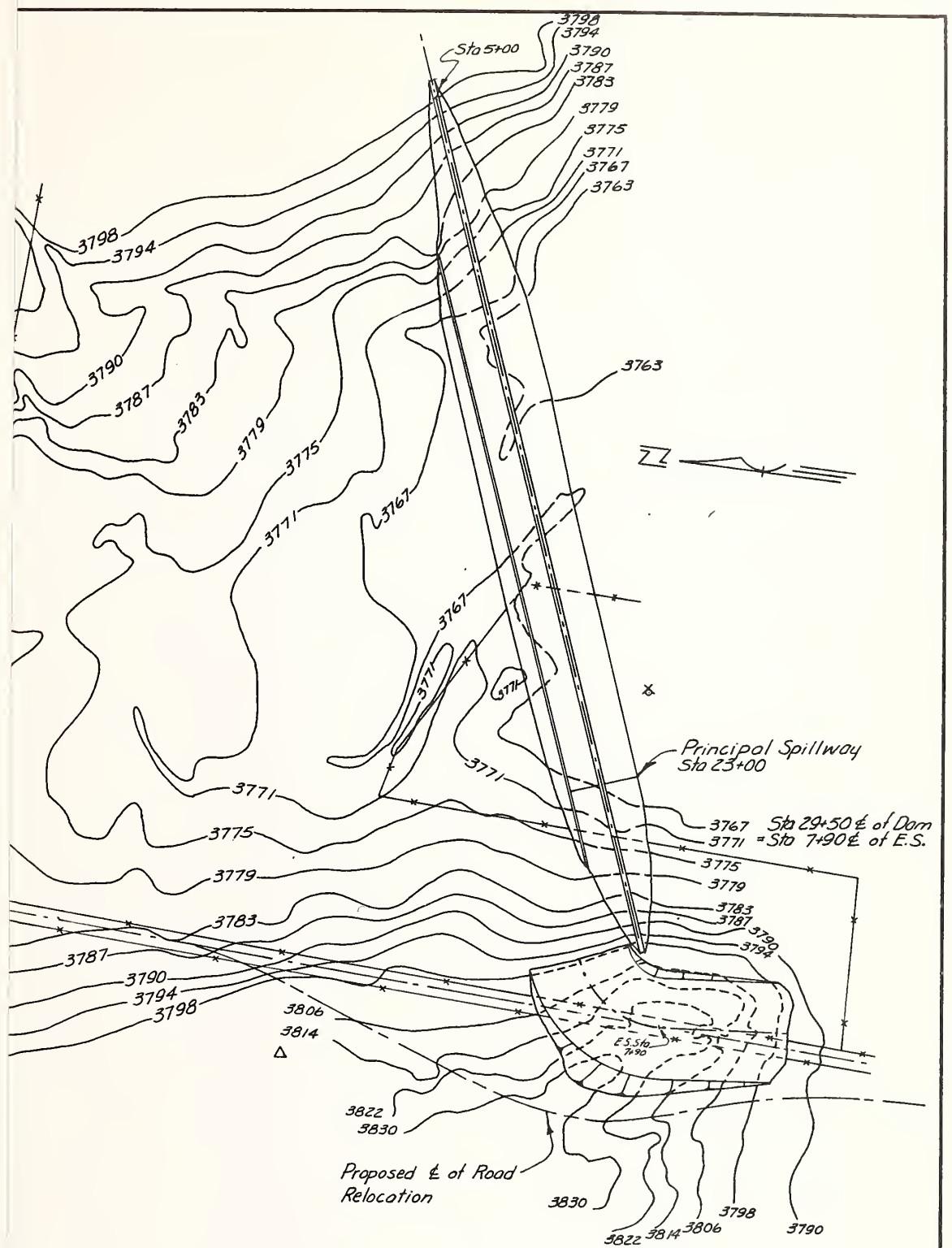
A period of 100 years was used as being the expected useful life of the project. The interest rate used for converting benefits and costs to a common time base and discounting future benefits is 5-1/2 percent. Associated capital costs were converted to their annual equivalent value by using the prevailing local interest rate of 8 percent.

## MAPS AND EXHIBITS SECTION

### SEDGWICK-SAND DRAWS WATERSHED

*Sedgwick County, Colorado  
Cheyenne & Deuel Counties, Nebraska*





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### DIR AND DAM SITE

#### FLOODWATER RETARDING STRUCTURE SS-3 SEDGWICK-SAND DRAWS WATERSHED

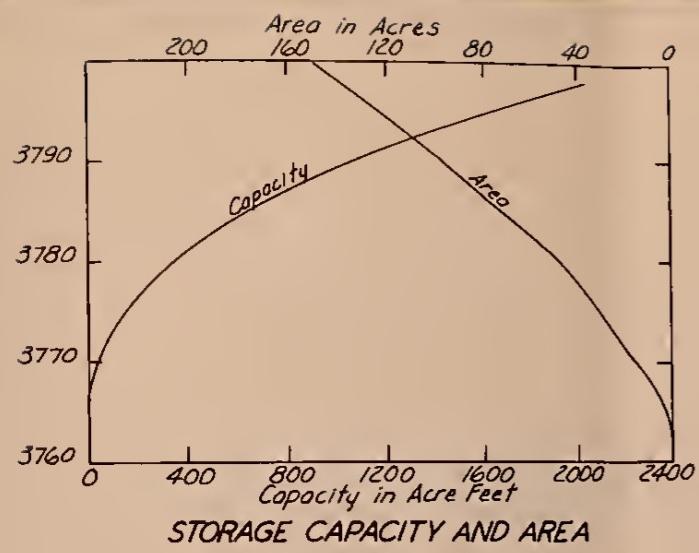
SEDGWICK COUNTY  
CHEYENNE & DEUEL COUNTIES

COLORADO  
NEBRASKA

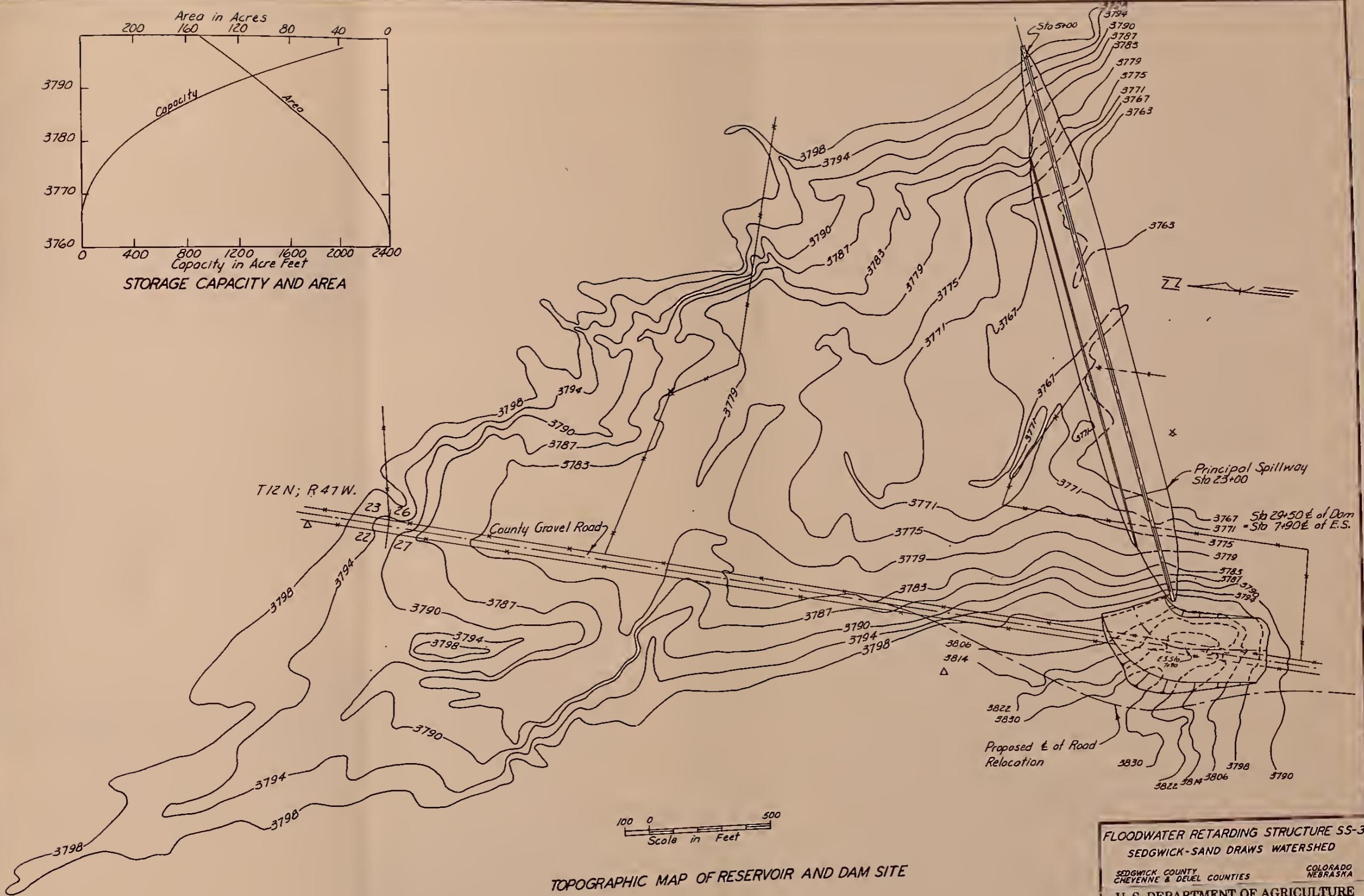
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

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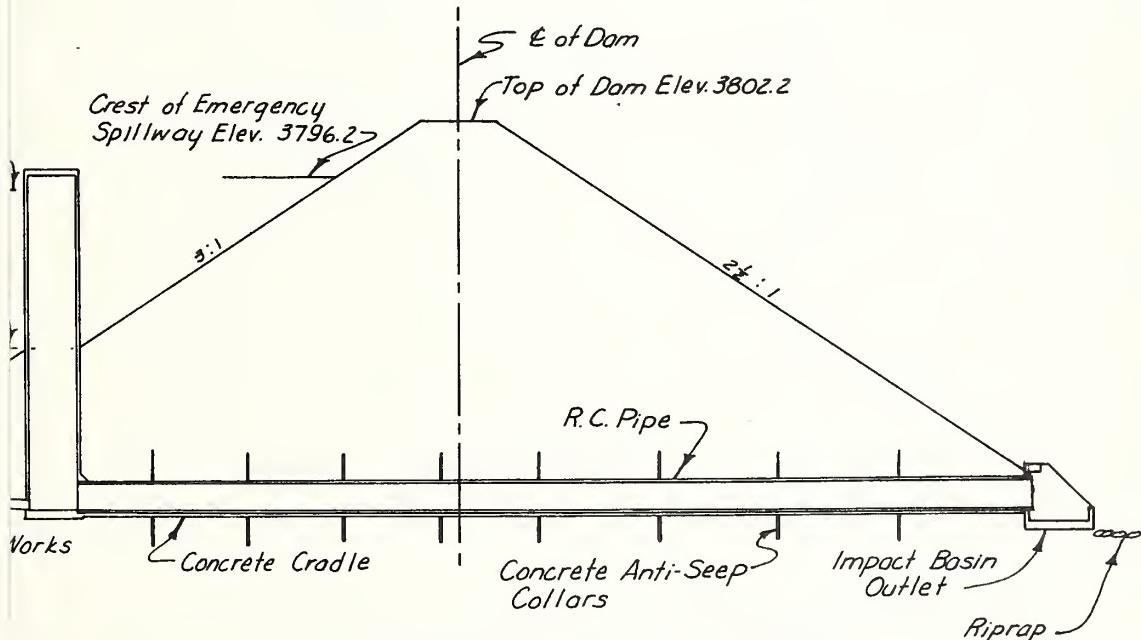
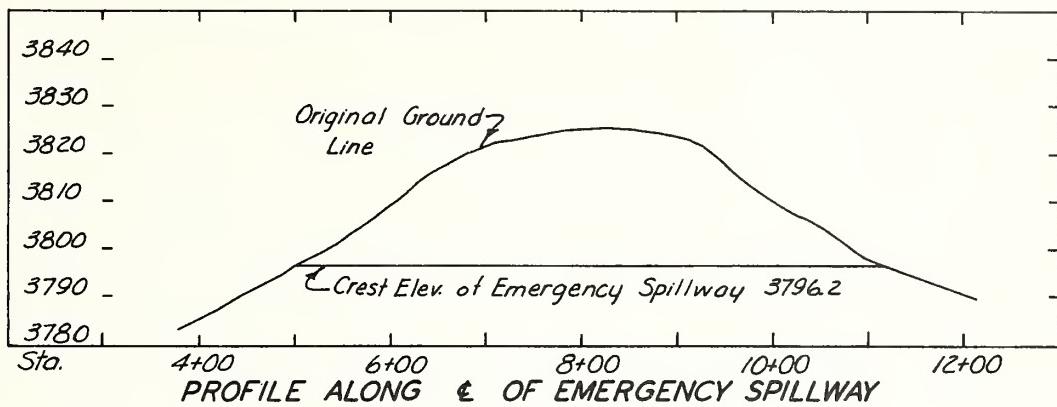
### **STORAGE CAPACITY AND AREA**



TOPOGRAPHIC MAP OF RESERVOIR AND DAM SITE

FLOODWATER RETARDING STRUCTURE SS-3	
SEDGWICK-SAND DRAWS WATERSHED	
SEDWICK COUNTY CHEYENNE & DEUEL COUNTIES	COLORADO NEBRASKA
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
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FIGURE 1	





Note:  
Cross Sections are Typical of  
all Project Floodwater Retarding  
Structures.

FLOODWATER RETARDING STRUCTURE SS-3  
SEDGWICK-SAND DRAWS WATERSHED

SEDGWICK COUNTY  
CHEYENNE & DEUEL COUNTIES

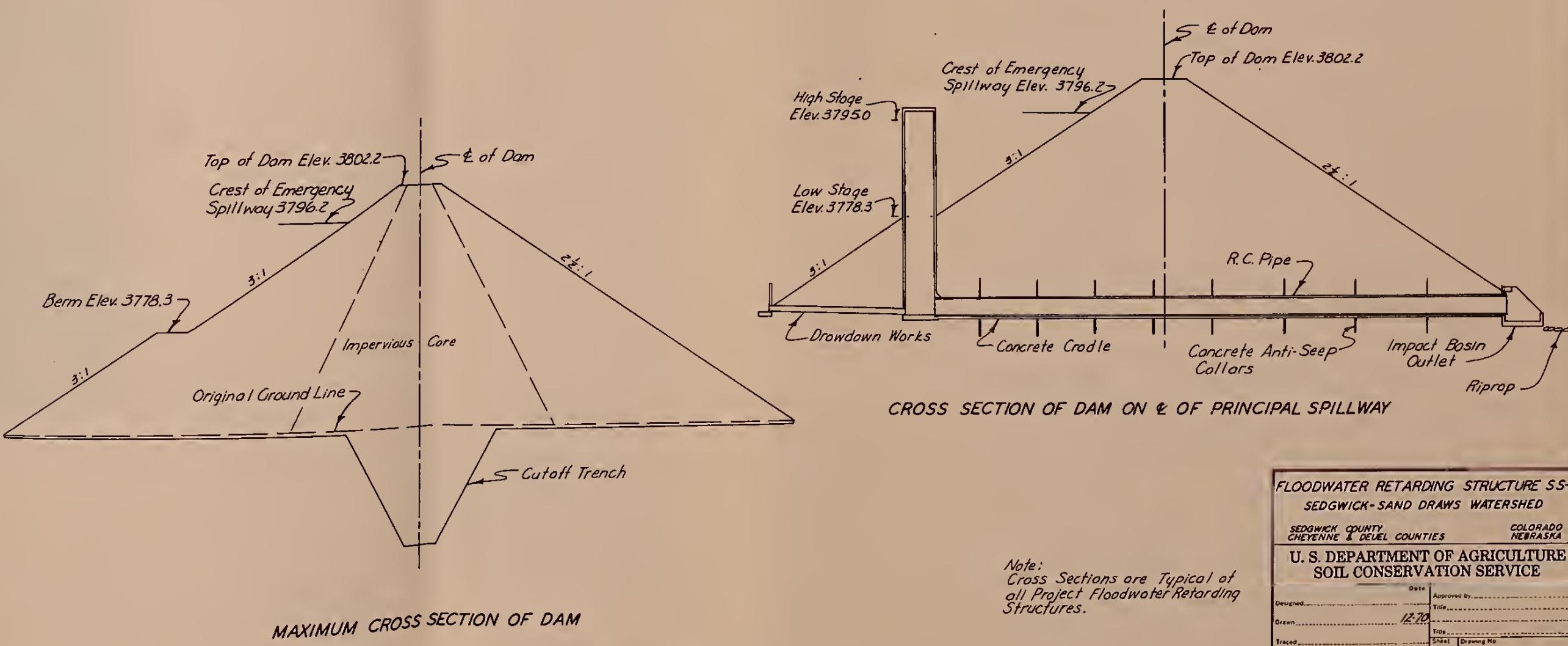
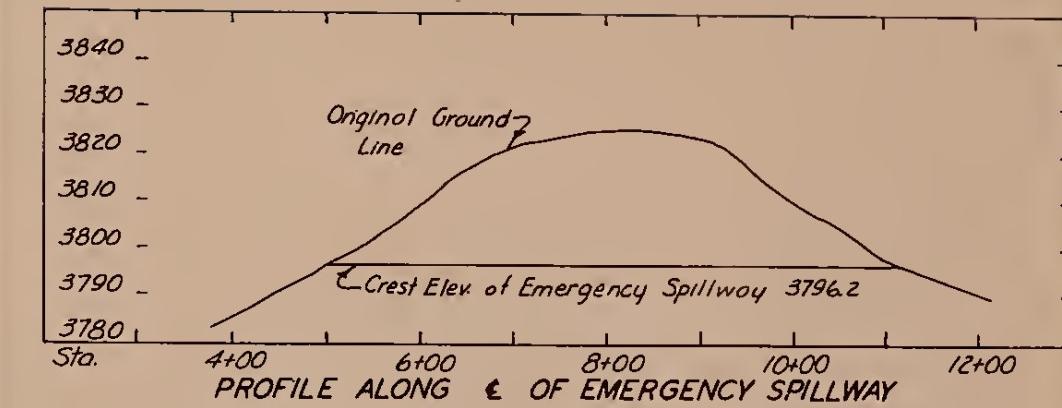
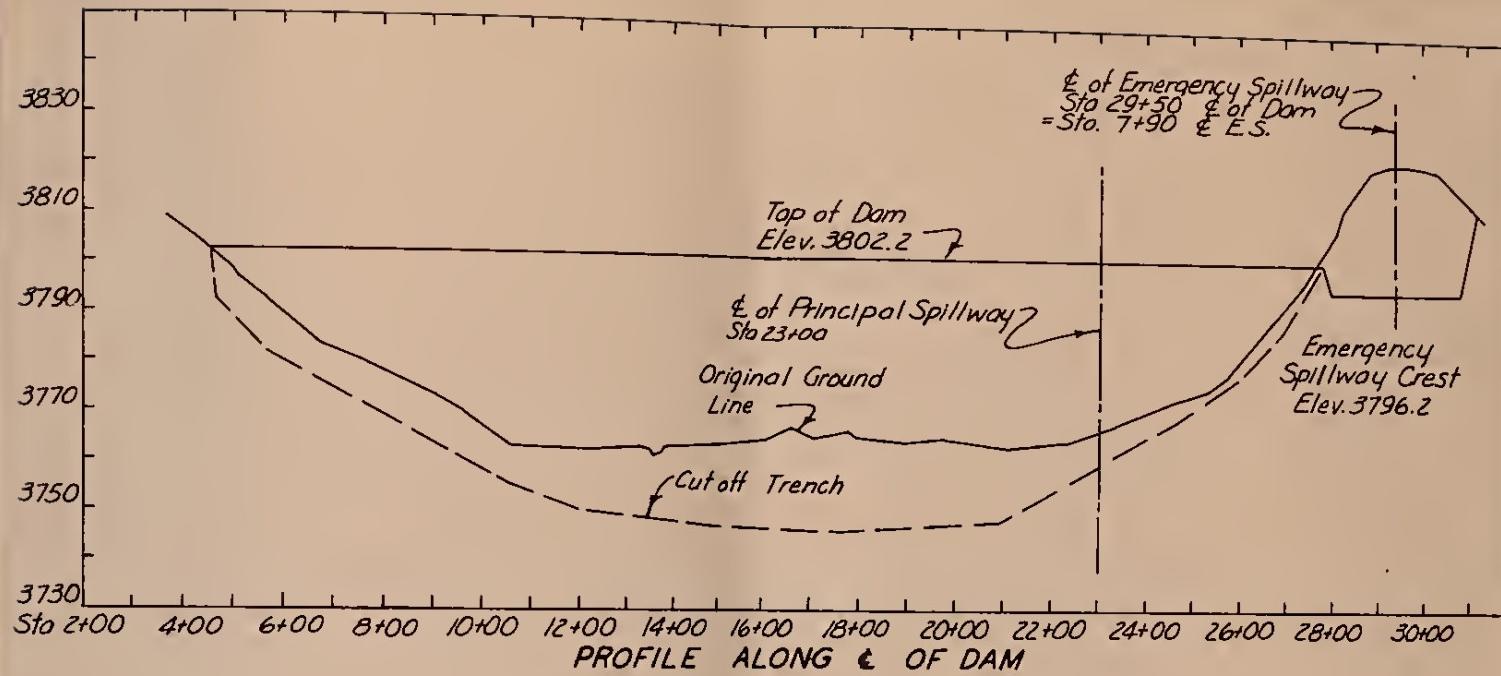
COLORADO  
NEBRASKA

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

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FIGURE 2





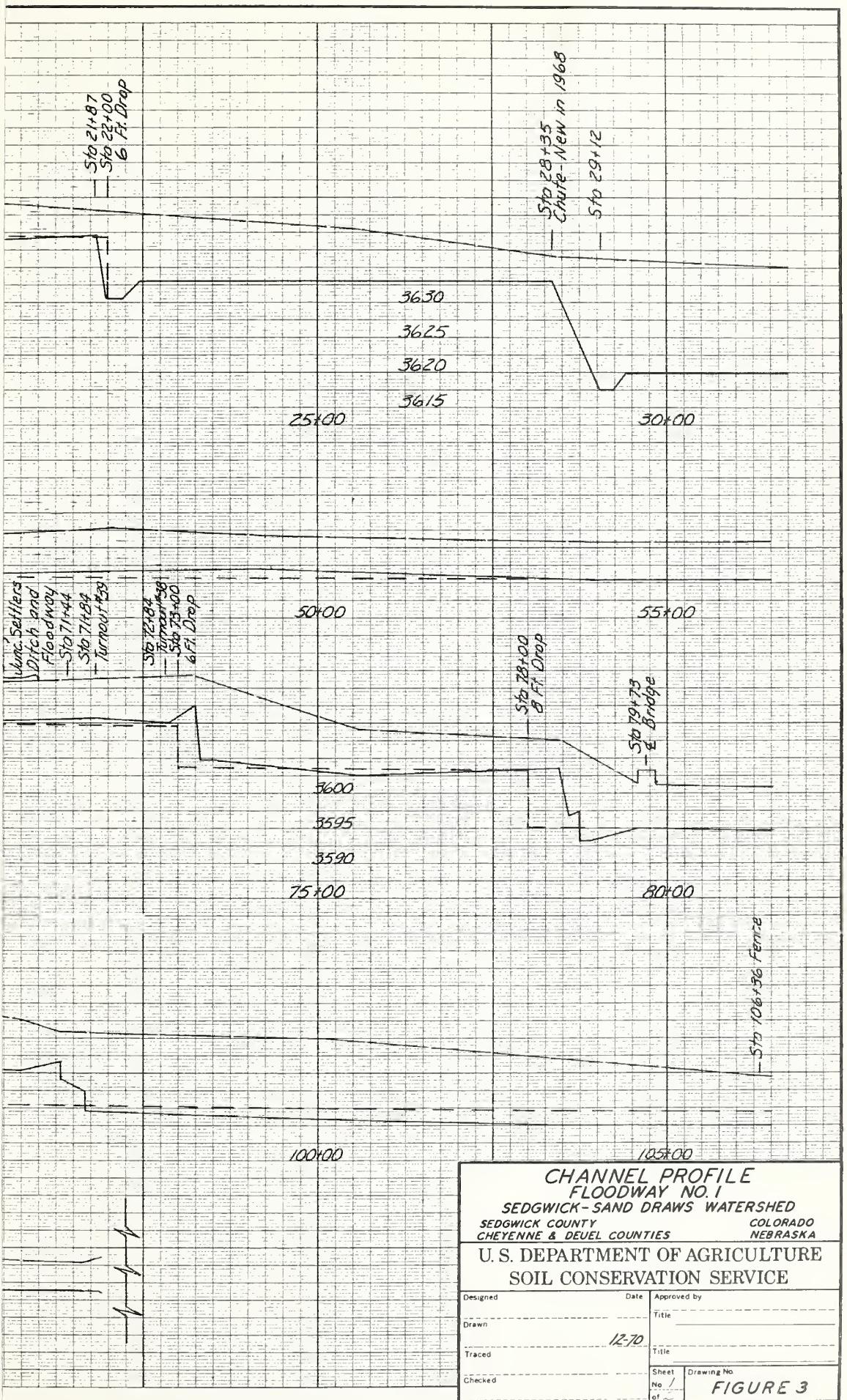
CROSS SECTION OF DAM ON E OF PRINCIPAL SPILLWAY

Note:  
Cross Sections are Typical of  
all Project Floodwater Retarding  
Structures.

FLOODWATER RETARDING STRUCTURE SS-3	
SEDGWICK-SAND DRAWS WATERSHED	
SEDGWICK COUNTY CHEYENNE & DEVEL COUNTIES	
COLORADO NEBRASKA	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
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FIGURE 2

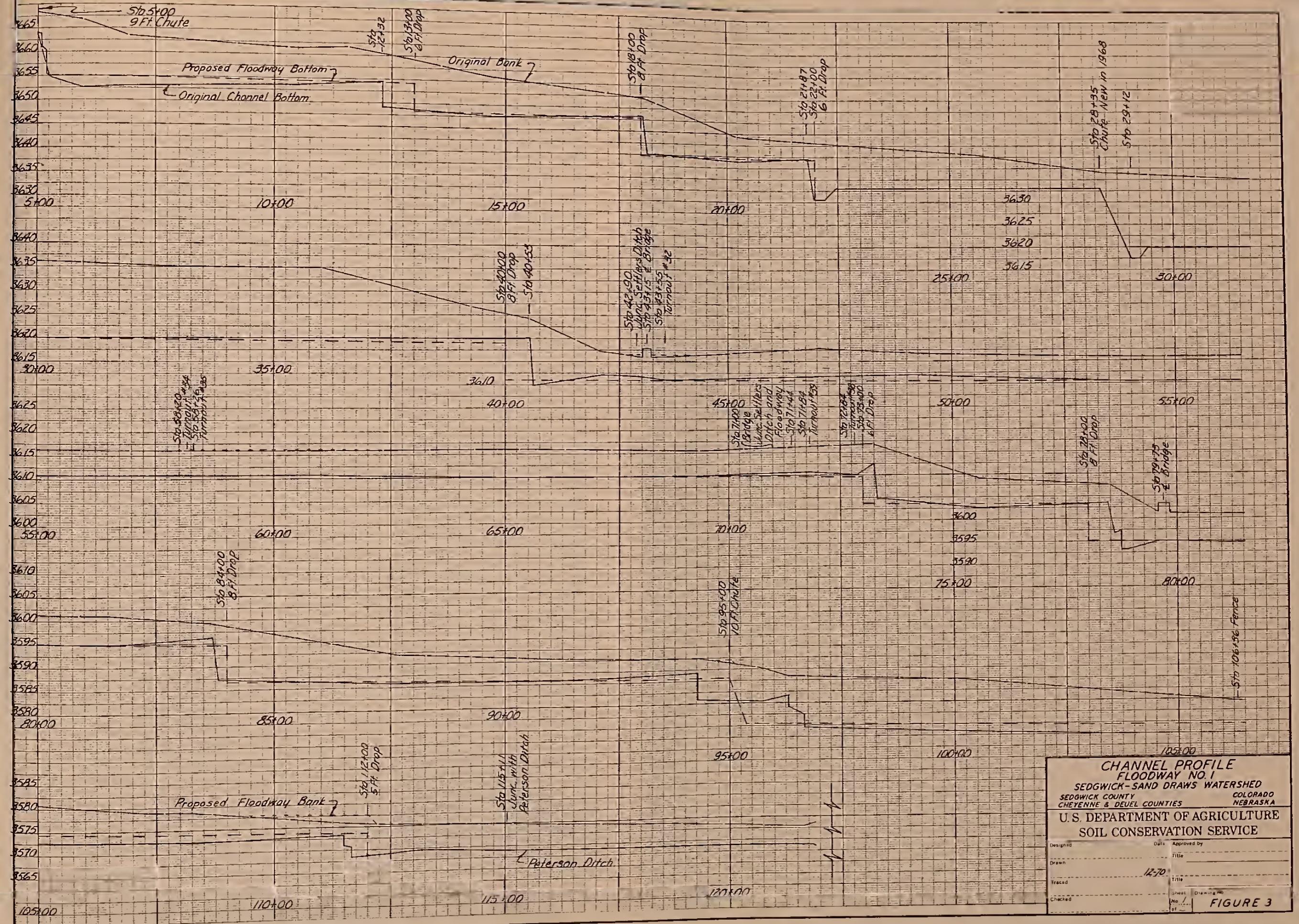




-510 106+36 fence

FIGURE 3





CHANNEL PROFILE FLOODWAY NO. 1	
SEDGWICK-SAND DRAWS WATERSHED	
SEDGWICK COUNTY CHEYENNE & DEUEL COUNTIES	
COLORADO NEBRASKA	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
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FIGURE 3



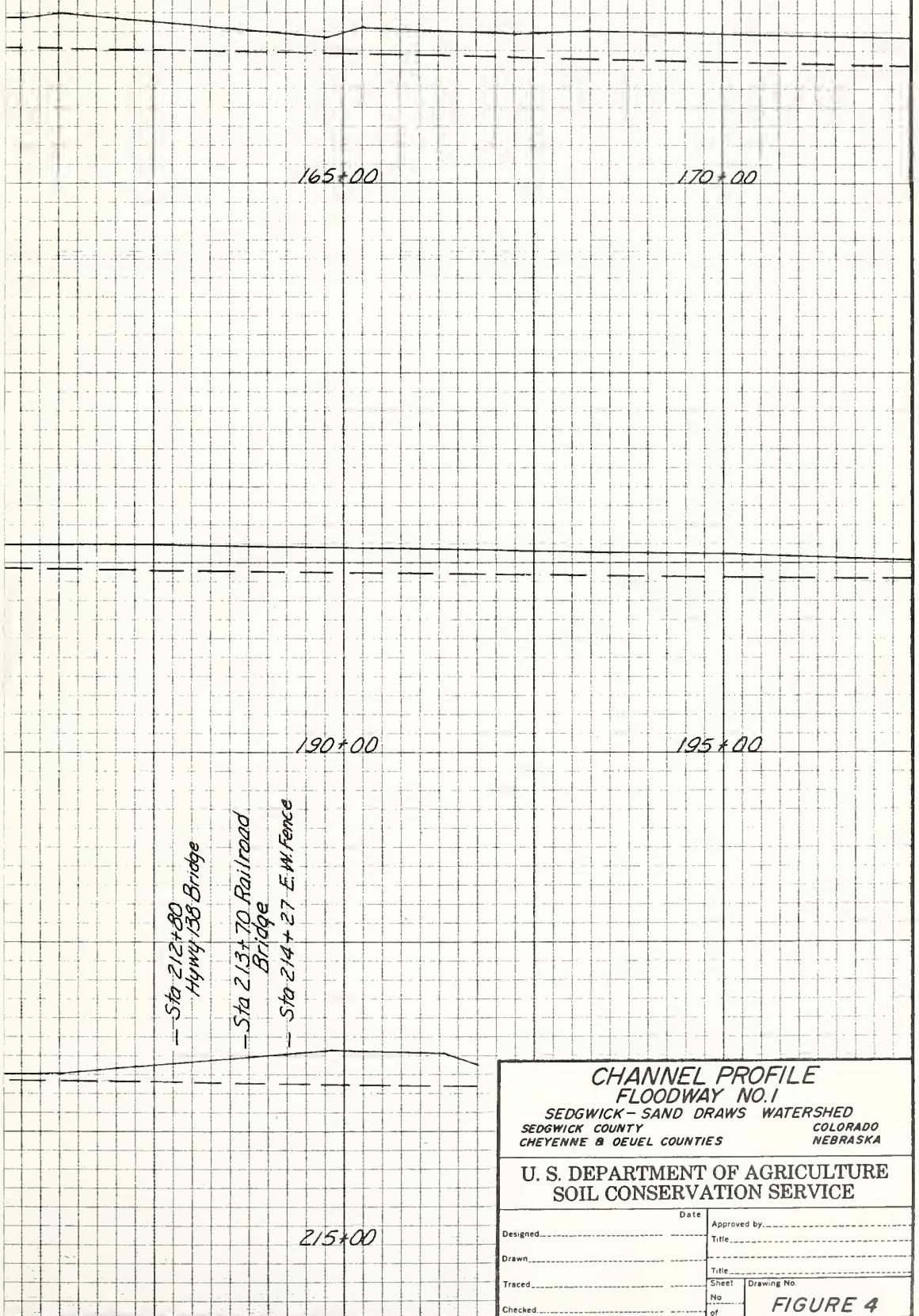
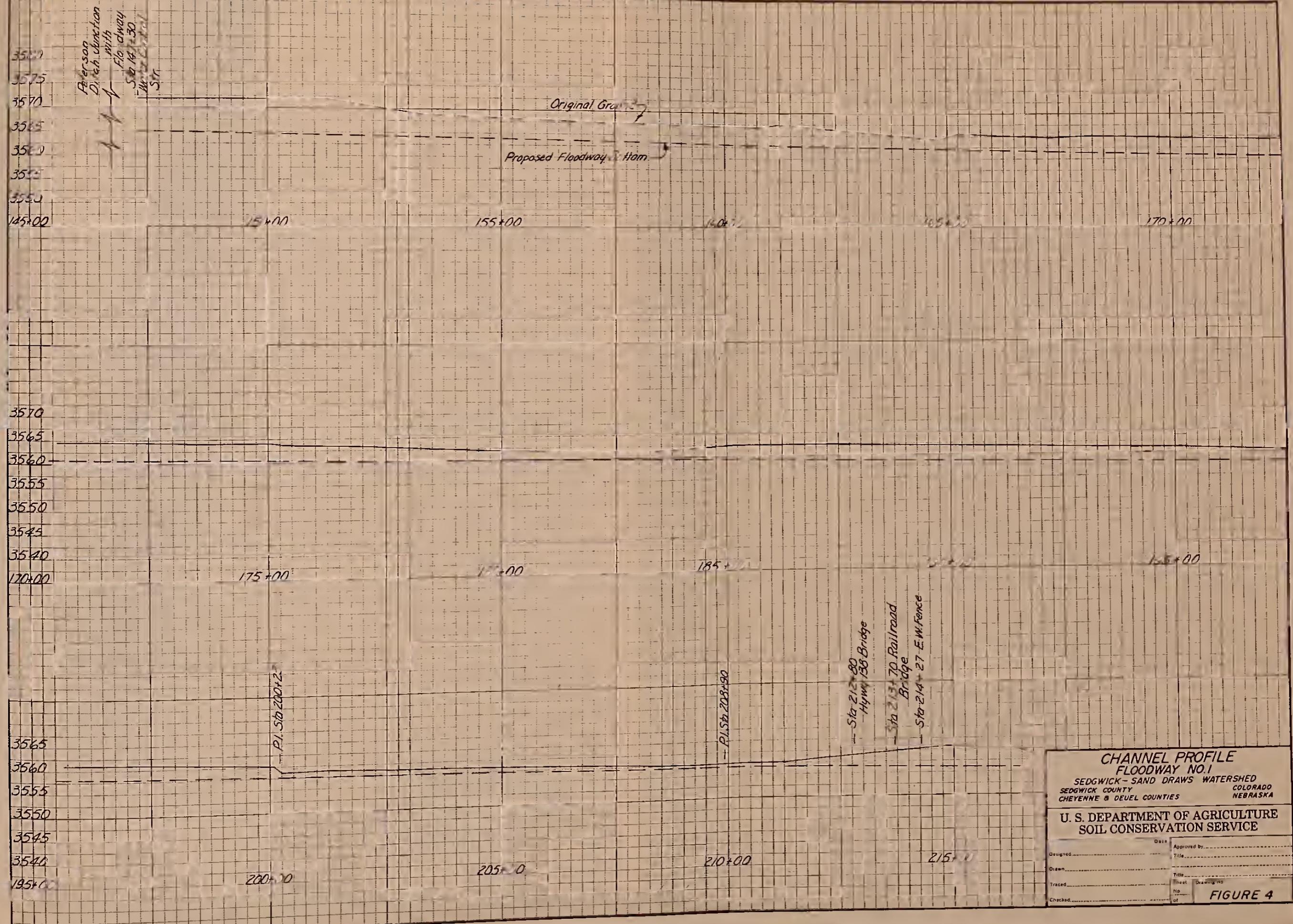


FIGURE 4





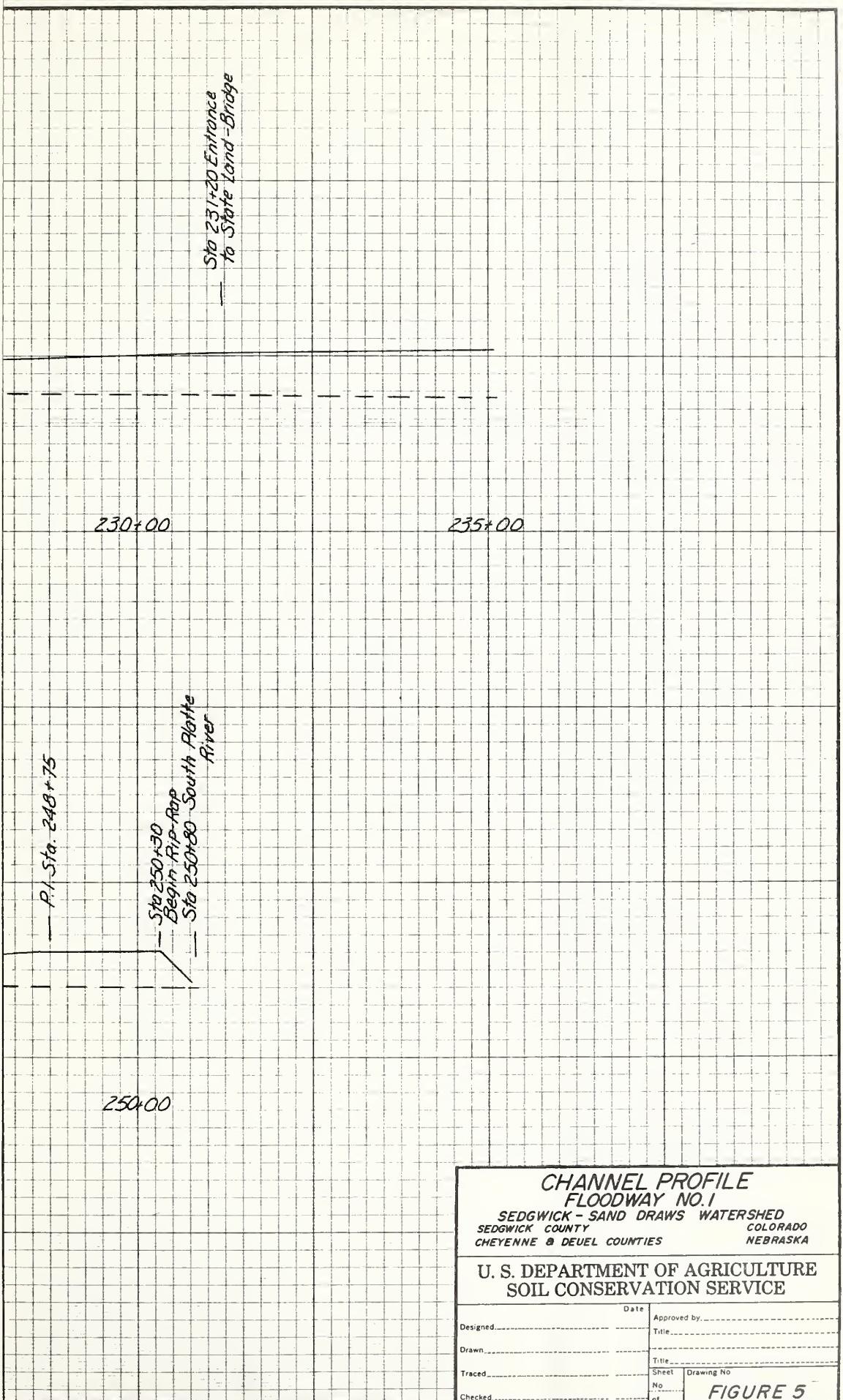
CHANNEL PROFILE  
 FLOODWAY NO. 1  
 SEDGWICK - SAND DRAWS WATERSHED  
 SEDGWICK COUNTY  
 CHEYENNE & ODEU COUNTY  
 COLORADO NEBRASKA

U. S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

Approved by:	Date:
Designed by:	Date:
Drawn by:	Date:
Traced by:	Date:
Checked by:	Date:

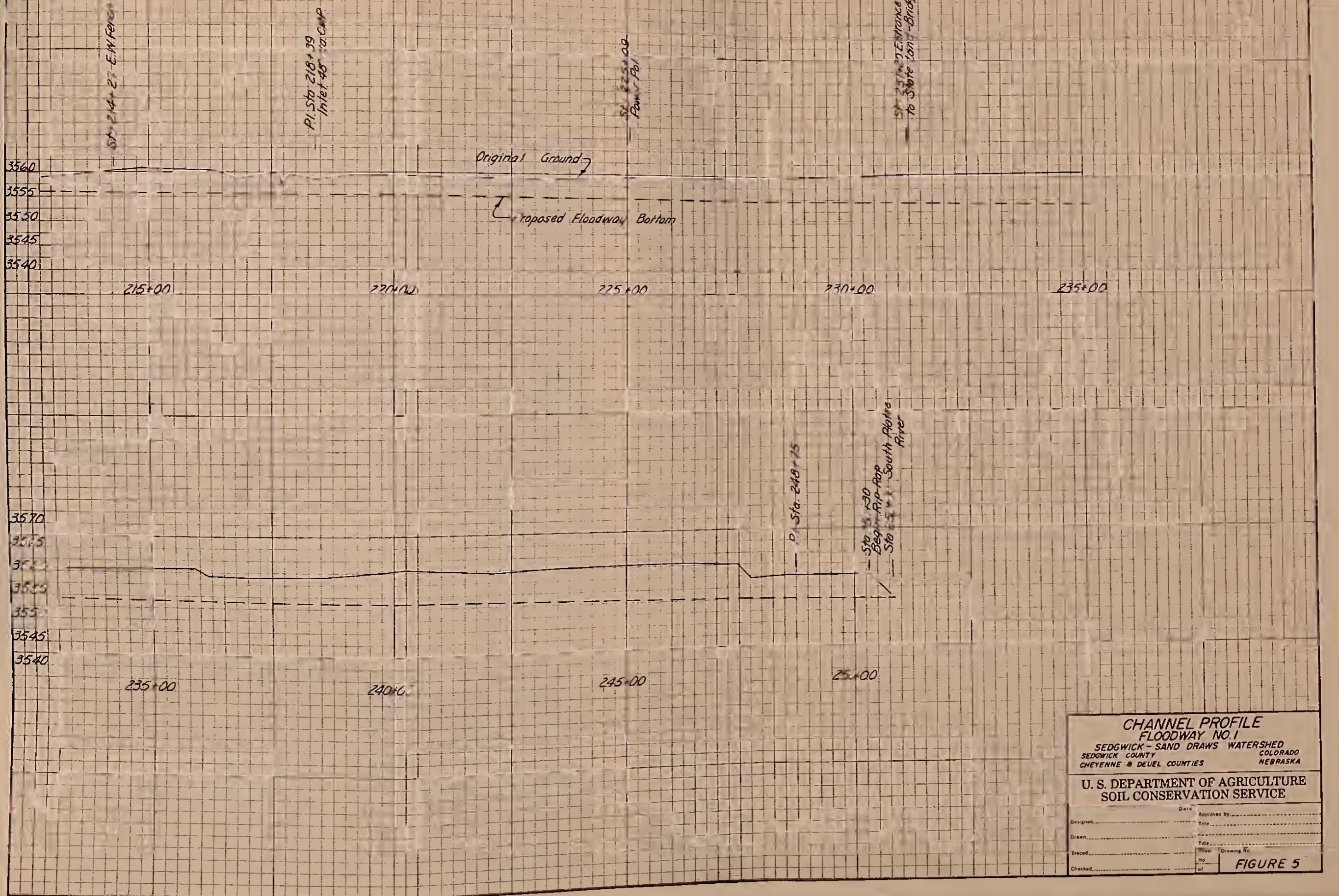
FIGURE 4



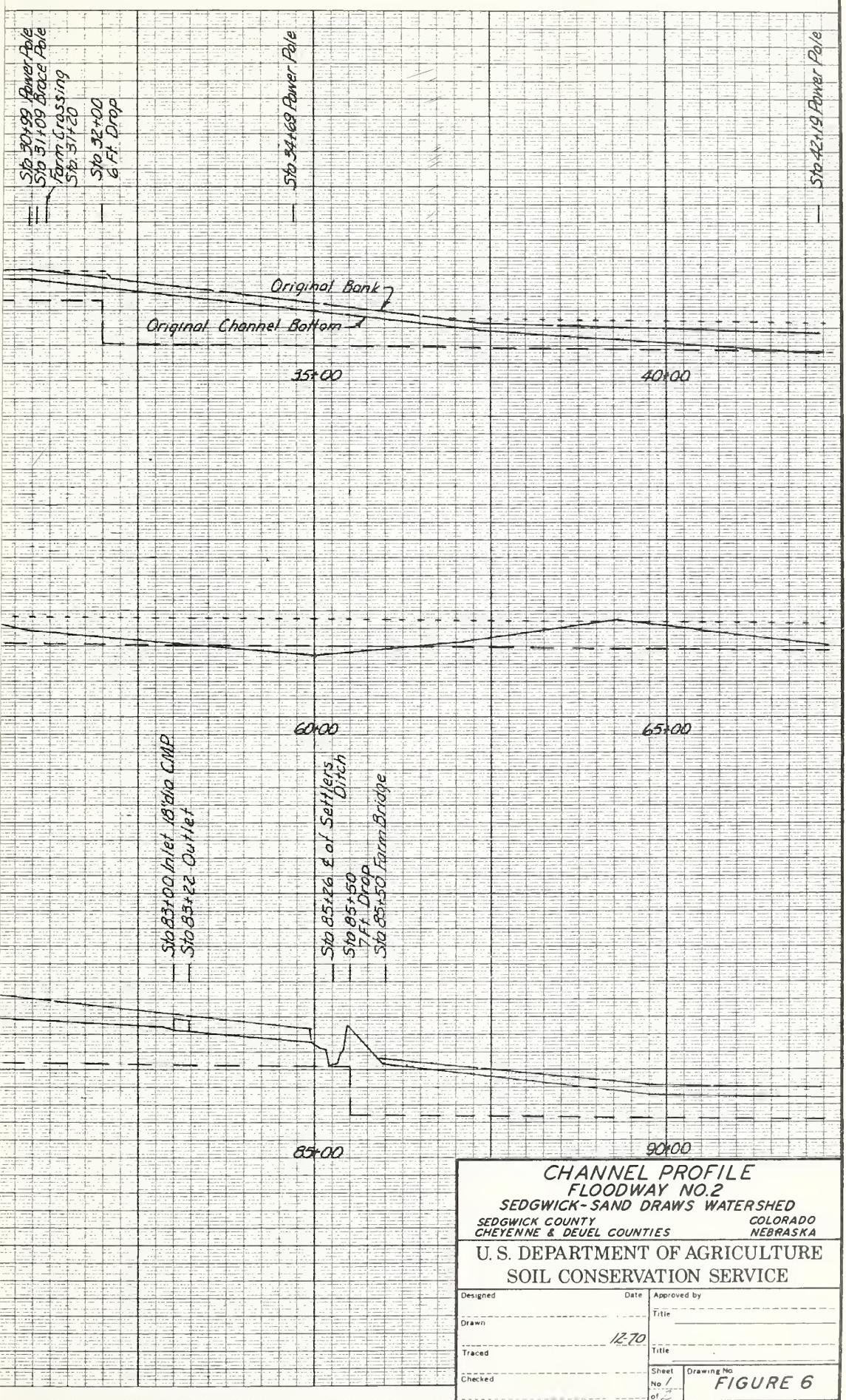


*FIGURE 5*

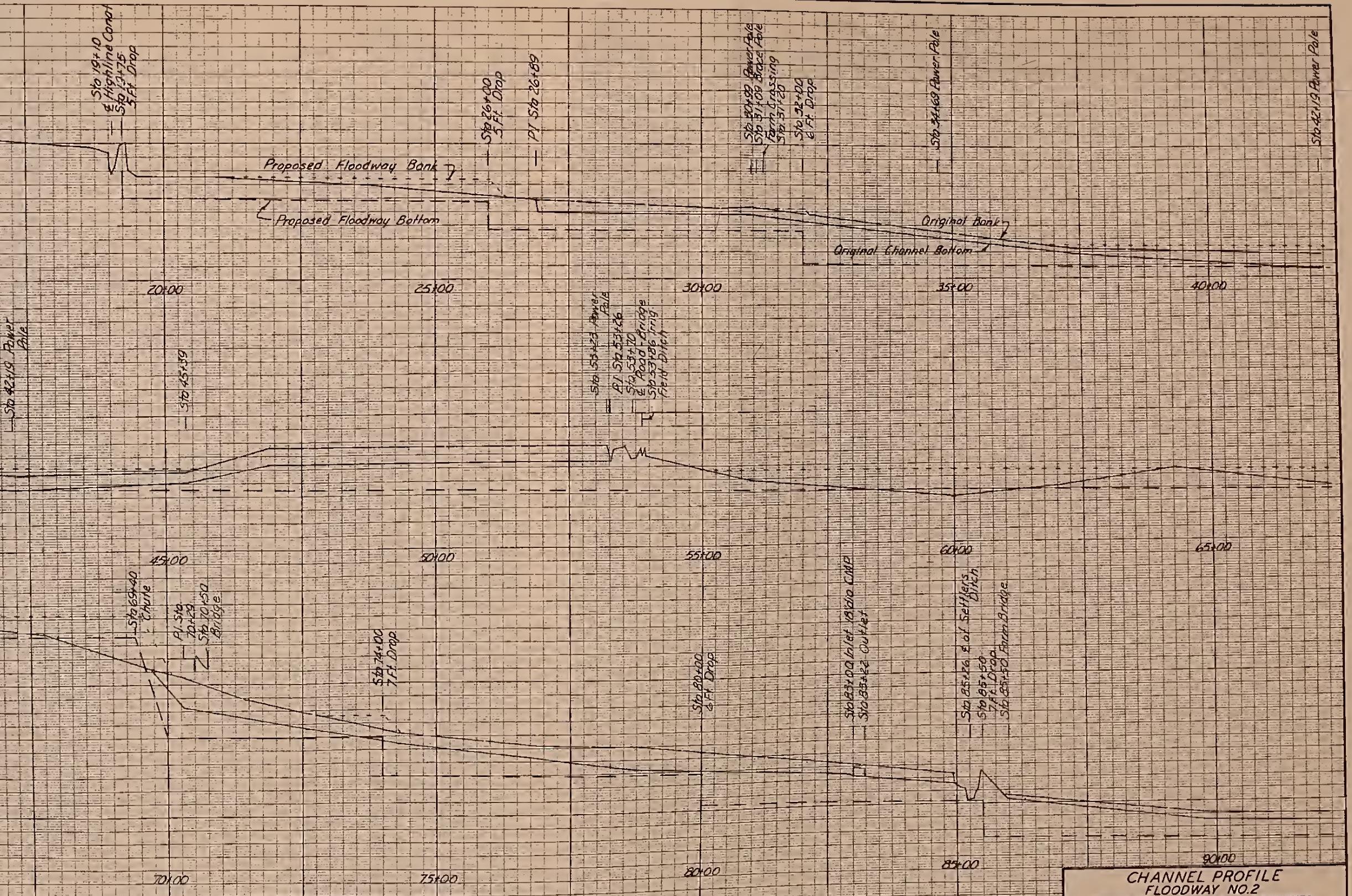












90100

**CHANNEL PROFILE  
FLOODWAY NO.2**

**SEDGWICK-SAND DRAWS WATERSHED**

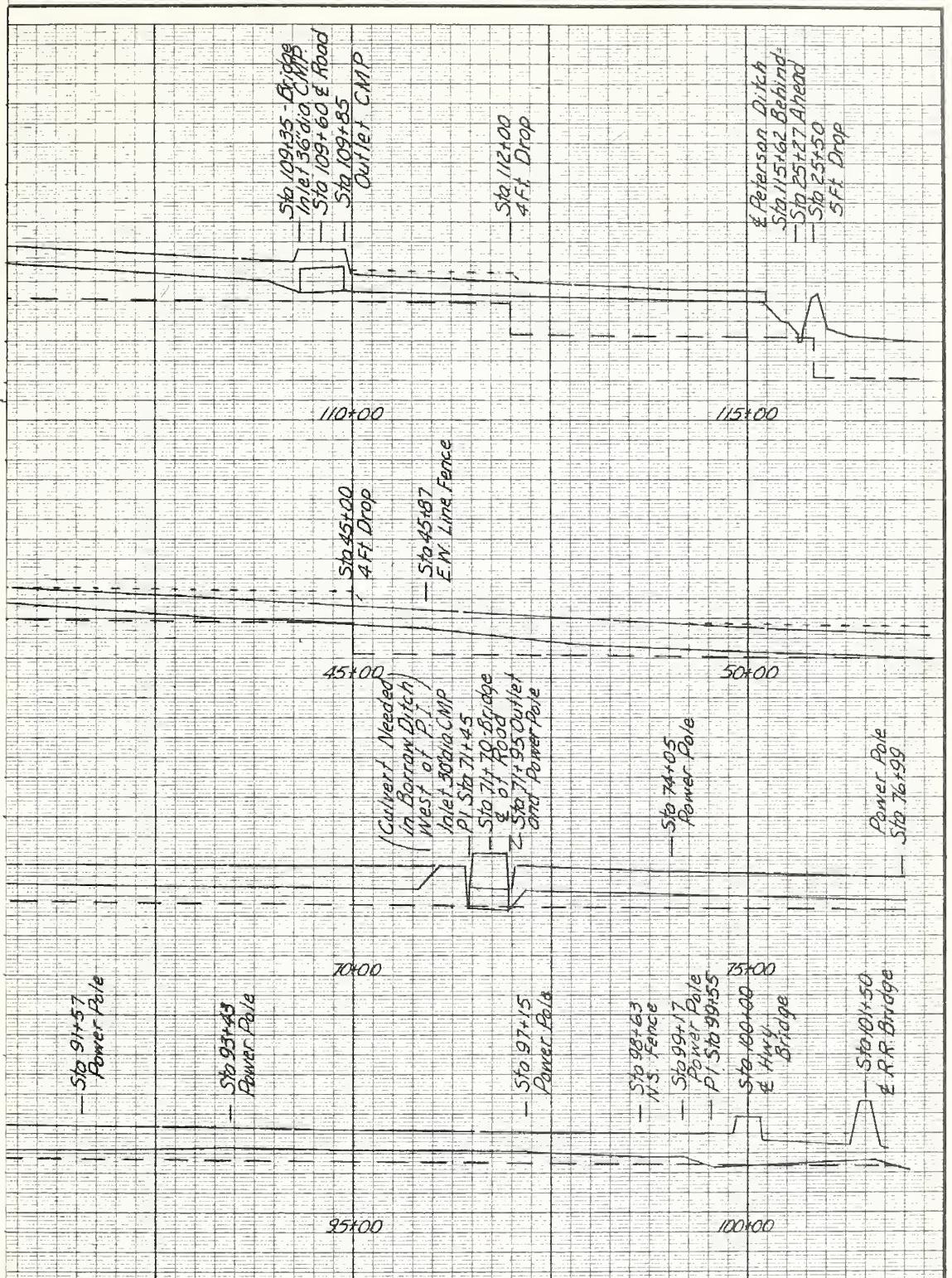
**SEGWICK COUNTY COLORADO**  
**EYENNE & DEUEL COUNTIES NEBRASKA**

**S. DEPARTMENT OF AGRICULTURE**  
**SOIL CONSERVATION SERVICE**

Date _____	Approved by _____
Title _____	
Title _____	
Sheet No. _____	
Drawing No. _____	

**FIGURE 6**





CHANNEL PROFILE FLOODWAY NO. 2 SEDGWICK-SAND DRAWS WATERSHED SEDGWICK COUNTY CHEYENNE & DEUEL COUNTIES U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE		
Designed	Date	Approved by
Drawn		Title _____
Traced	12-70	Title _____
Checked		Sheet No. 2 of 2 Drawing No. FIGURE 7

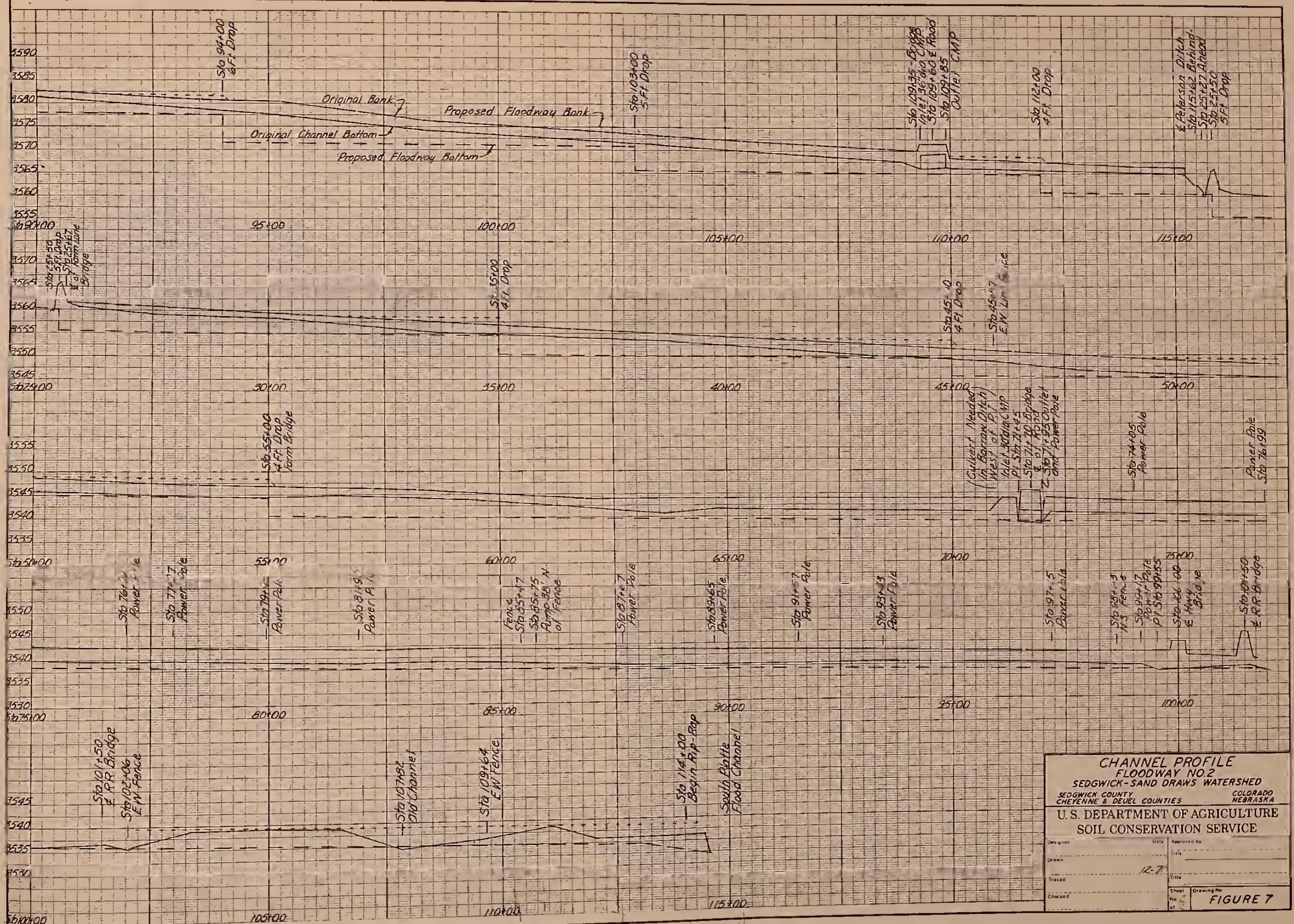
E Peterson Ditch  
Sta 1/5+62 Behind  
Sta 25+27 Ahead  
Sta 25+50  
5FT Drop

Power Pole  
Sta 71+99

Sta 100+50  
E.R.R. Bridge

COLORADO  
NEBRASKA





**CHANNEL PROFILE  
FLOODWAY NO. 2  
WICK-SAND DRAWS WATERSHED**

STATE OF NEBRASKA DEPARTMENT OF AGRICULTURE

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Date | Approved by

----- 7478 -----

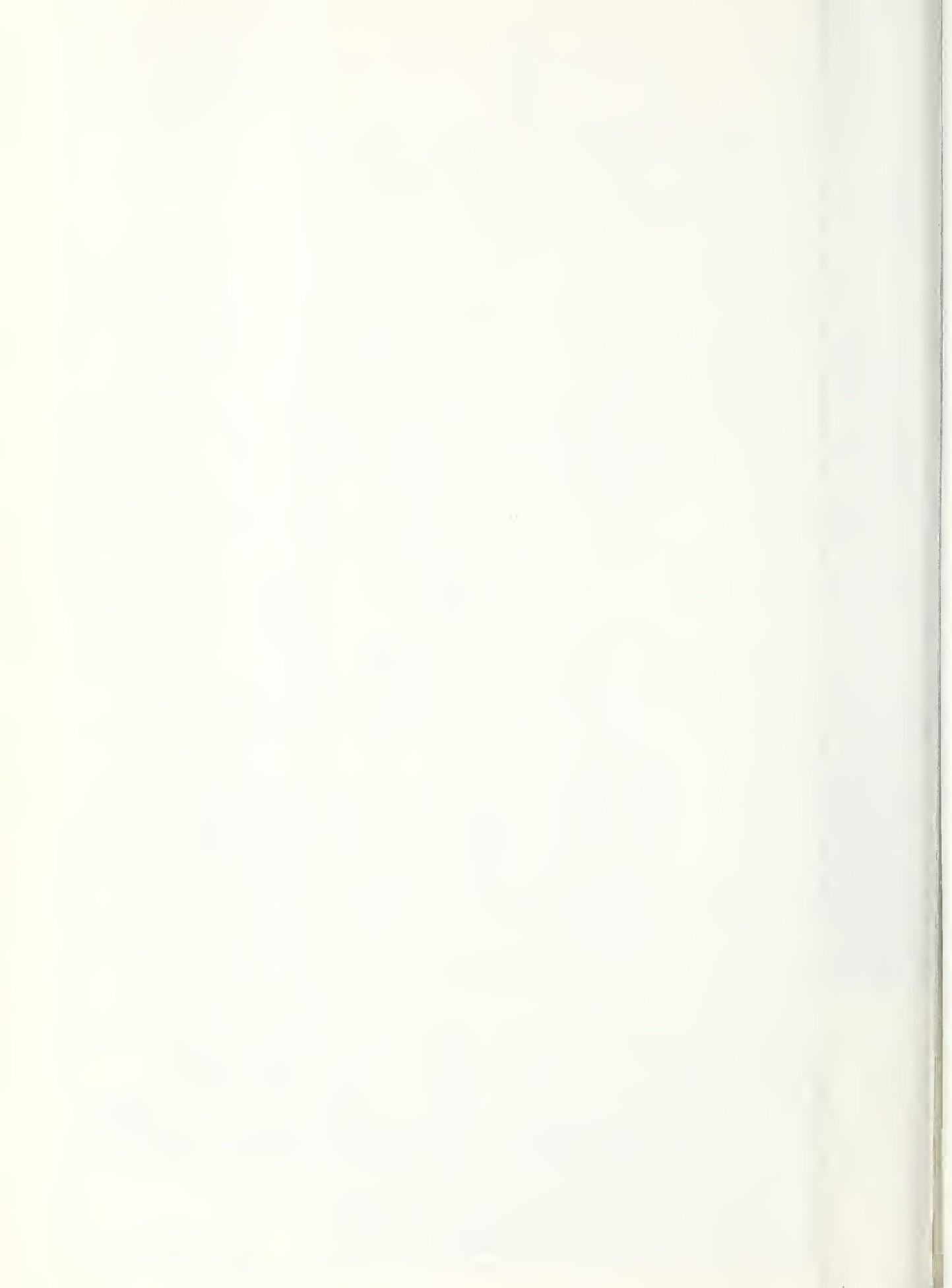
*R-7*

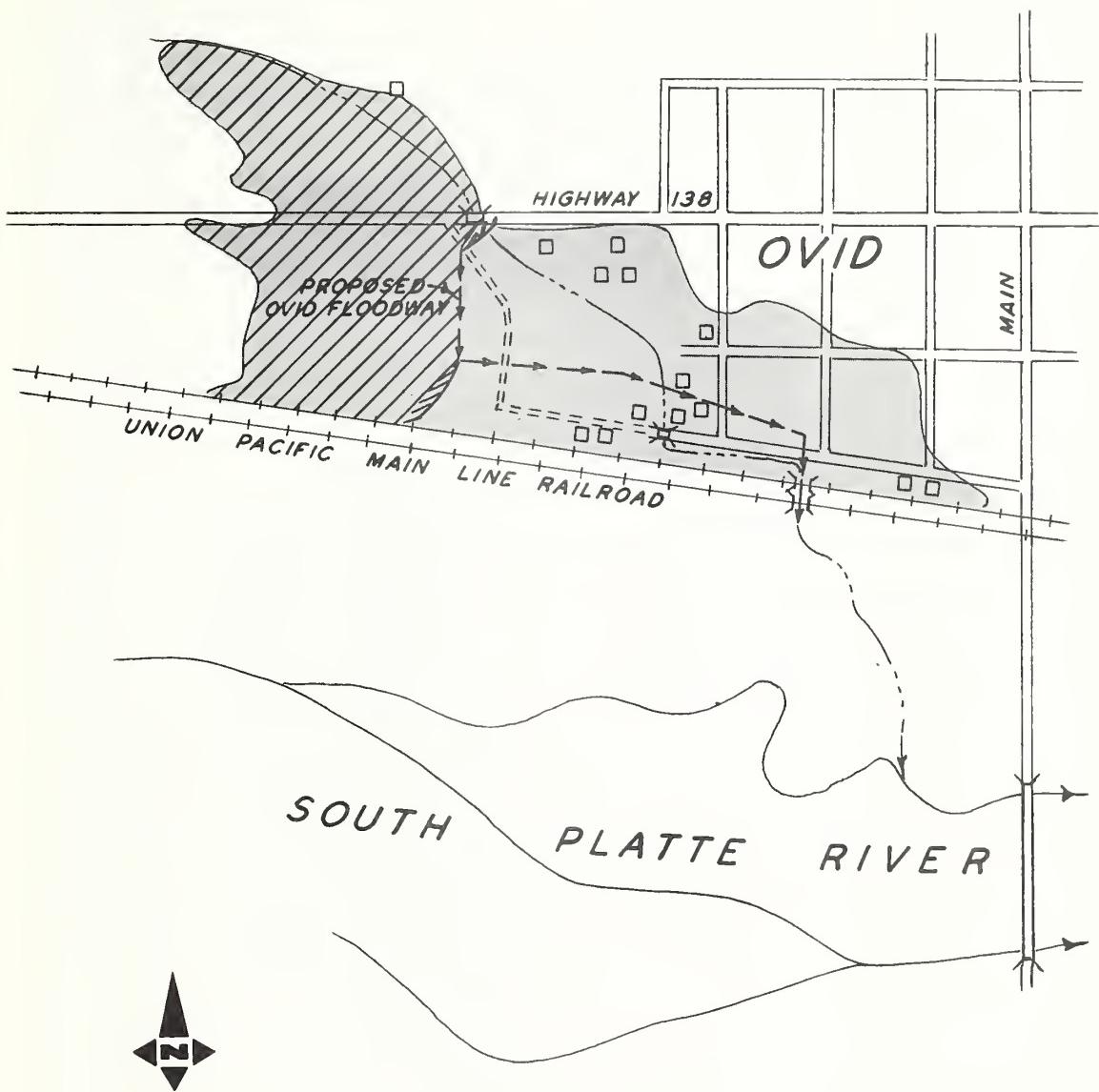
**Title** \_\_\_\_\_

**FIGURE 7**

FIGURE 7

FIGURE 7





500      0      500      1000  
SCALE IN FEET  
1" = 660'

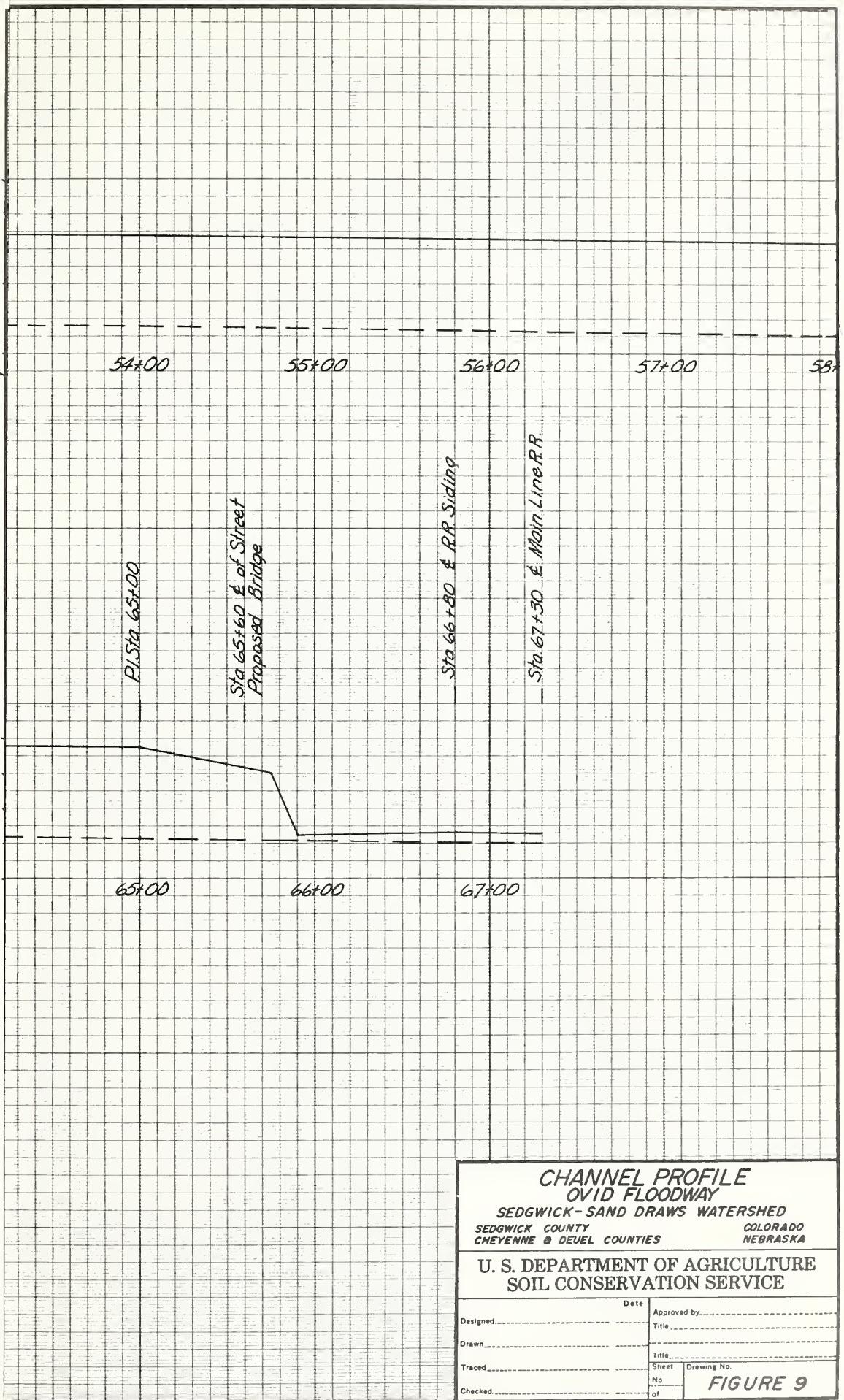
100 YR. FLOOD WITHOUT PROJECT  
100 YR. FLOOD WITH PROJECT



FLOOD PLAIN DAMAGE MAP  
100 YR. EVENT WITH AND WITHOUT PROJECT  
SEDGWICK - SAND DRAWS WATERSHED  
SEDWICK COUNTY,  
CHEYENNE & DEUEL COUNTIES,  
COLORADO  
NEBRASKA  
12-70

FIGURE 8

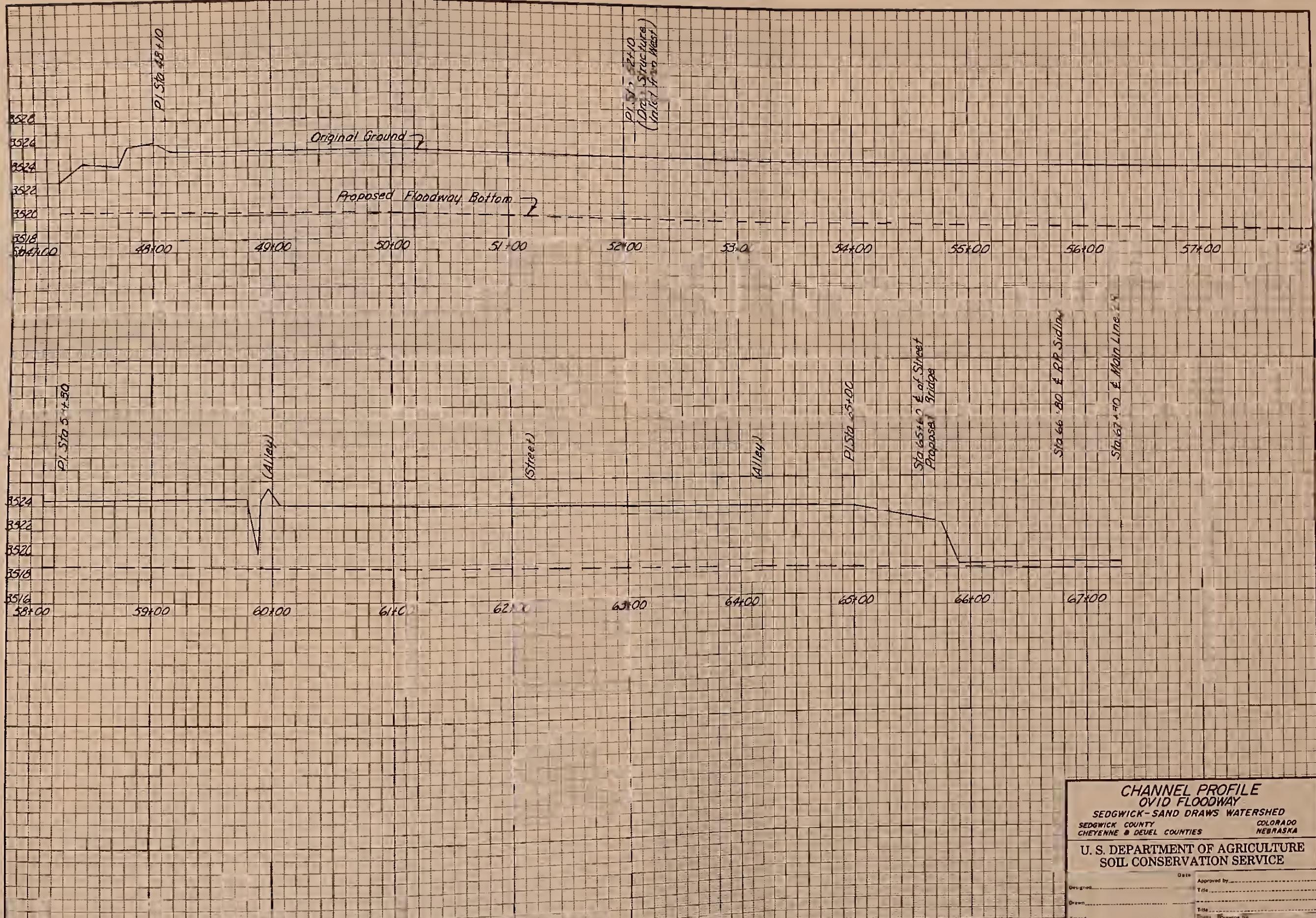




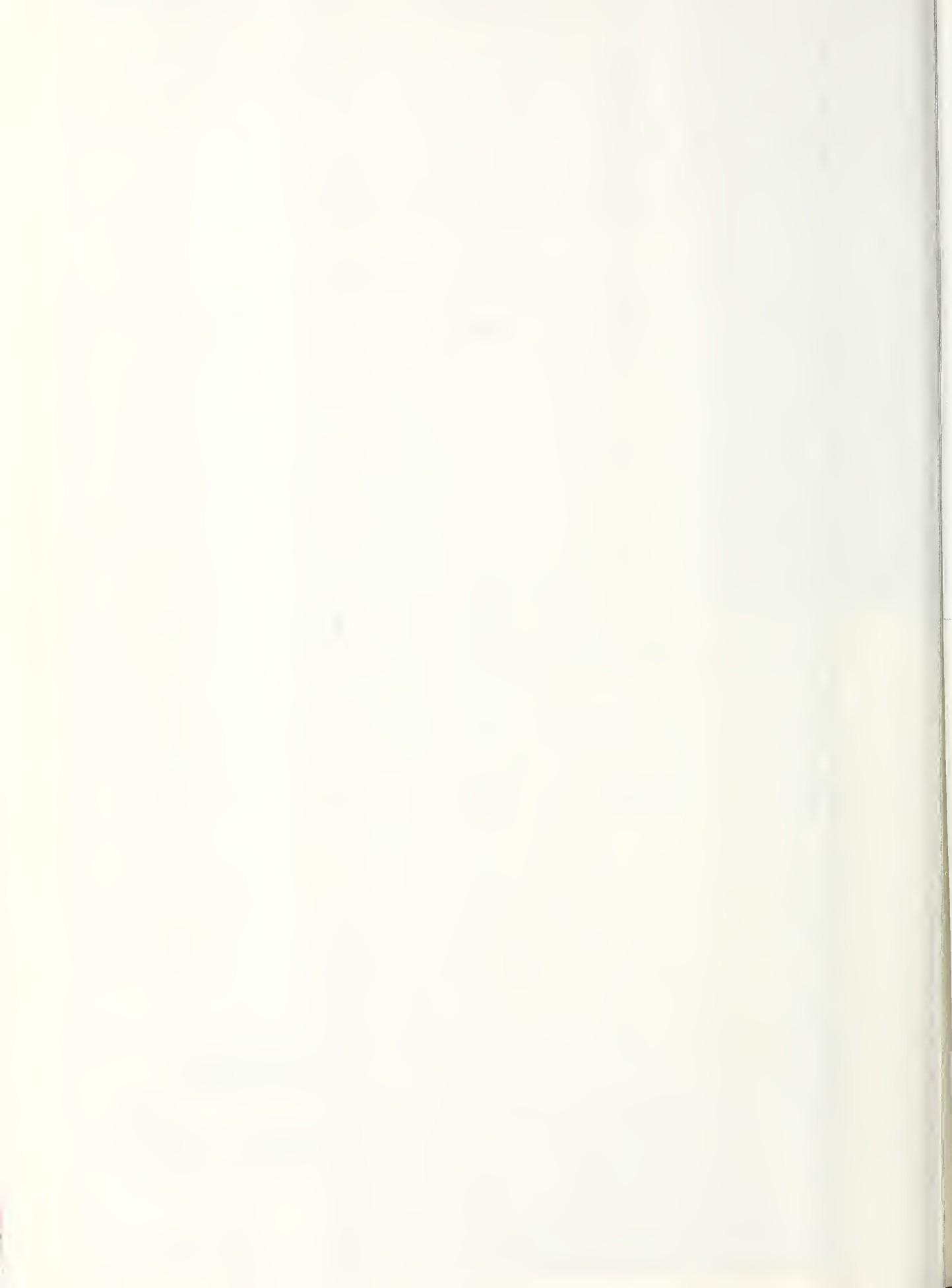
CHANNEL PROFILE	
OVID FLOODWAY	
SEDGWICK-SAND DRAWS WATERSHED	
SEDWICK COUNTY CHEYENNE & DEUEL COUNTIES	
COLORADO NEBRASKA	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed _____	Approved by _____
Drawn _____	Title _____
Traced _____	Title _____
Checked _____	Sheet _____ Drawing No. _____ No. _____ of _____

**FIGURE 9**



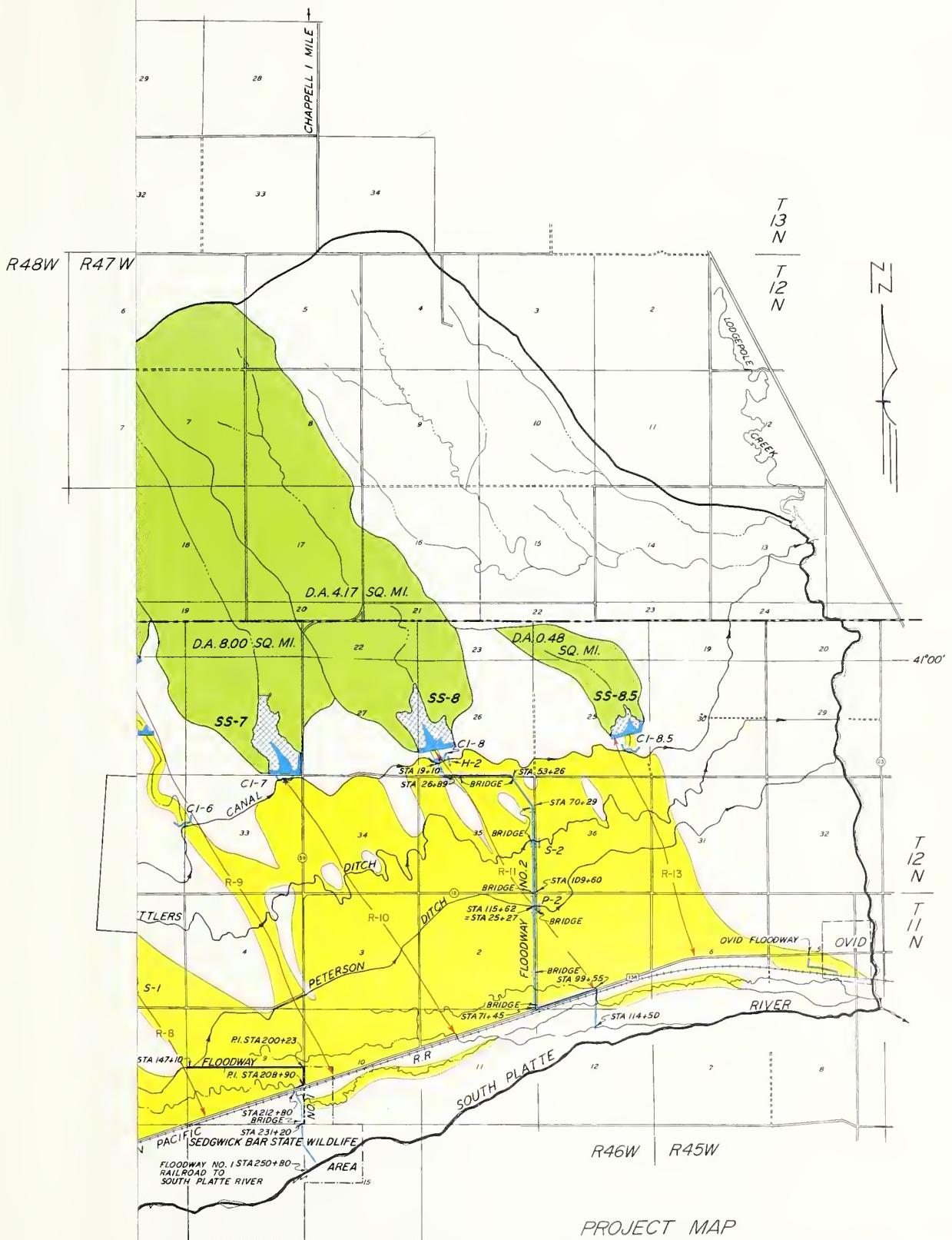


### FIGURE 9



102°30'

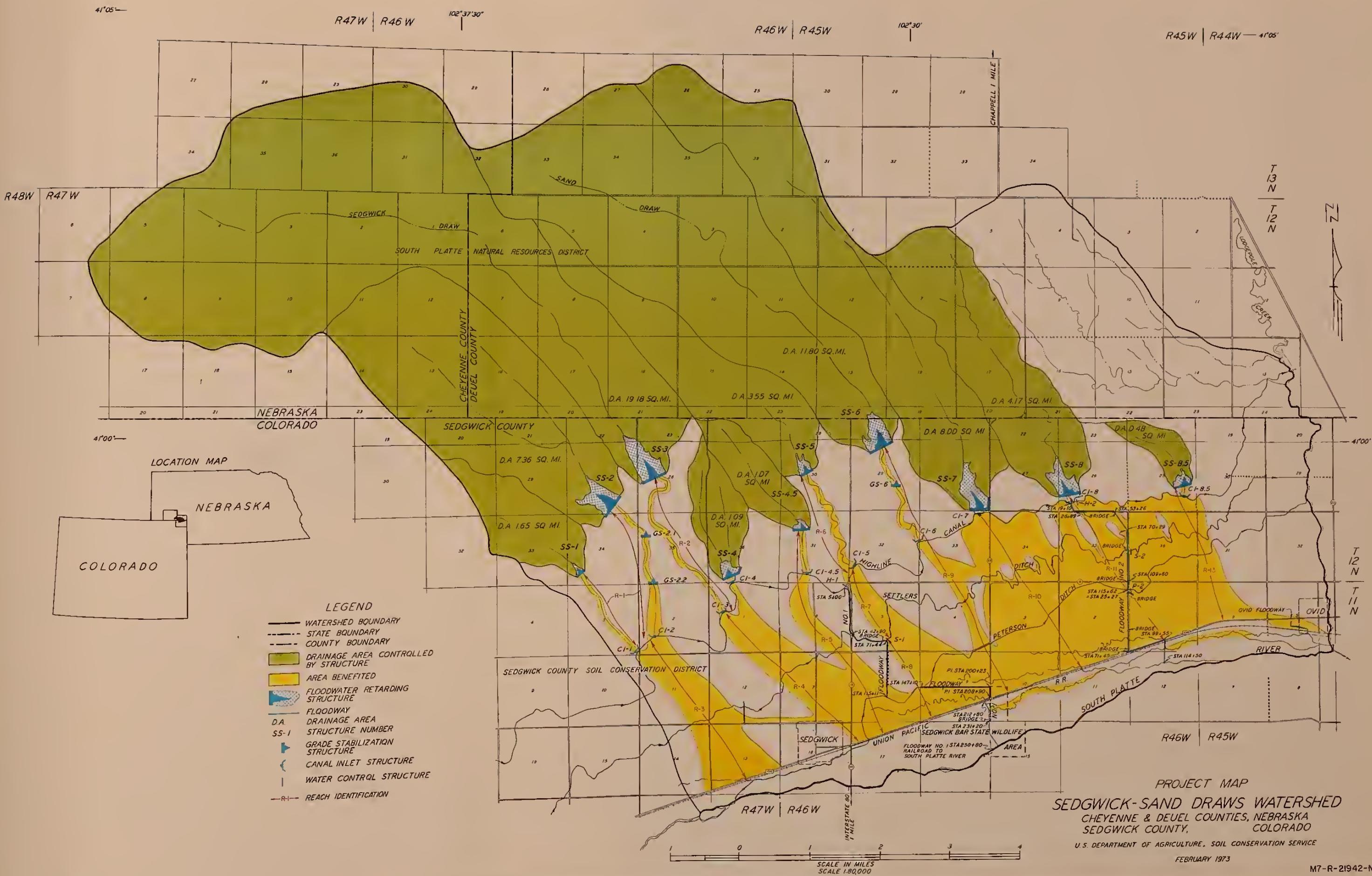
R45W | R44W — 41°05'



U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

FEBRUARY 1973







*A D D E N D U M*

*December 1974*

*WATERSHED WORK PLAN*

*SEDGWICK-SAND DRAWS WATERSHED  
Cheyenne & Deuel Counties, Nebraska  
Sedgwick County, Colorado*



## *INTRODUCTION*

*This addendum is based on the Water Resources Council's Principles and Standards for planning.*

*The Sedgwick-Sand Draws Watershed Work Plan was developed using 1972 installation costs and a 5-1/2 percent discount rate.*

*Part 1 of this Addendum shows a comparison of costs and benefits using 1973 installation costs, current normalized prices, and a discount rate of 5-7/8 percent.*

*Effects resulting from evaluation of the selected alternative are displayed under separate accounts for National Economic Development, Environmental Quality, Regional Development and Social Well-Being.*

*The Abbreviated Environmental Quality Plan has been developed using information and data assembled during investigations and analyses for the Environmental Impact Statement. The procedure used in developing the alternative and its content is included on a flow chart. The interrelationship of each step in this procedure is illustrated. The cost of \$6,500,000 for its installation is a preliminary estimate.*

*Implementation of features of this alternative will require acceptance by the Sponsors.*

**ADDENDUM**

**Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska**

*This Addendum shows the effect of evaluating the structural measures using a 5-7/8 percent discount rate, 1973 installation costs, current prices for values other than agricultural products and current normalized prices for agricultural products.*

*Average annual costs, benefits, and benefit/cost ratio are as follows:*

1. Average annual project costs ----- \$149,700
2. Average annual project benefits ----- 272,100
3. The project benefit/cost ratio ----- 1.8:1.0

*The alternative selected for implementation, as contained in the Sedgwick-Sand Draws Watershed Work Plan is based on a careful consideration of the environmental and economic impacts of the project. There are no known unresolved environmental issues. The final environmental statement has been modified in response to comments received on the draft environmental statement.*

*SELECTED ALTERNATIVE  
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT  
Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

<u>Components</u>	<u>Measures of Effects</u>	<u>1/ Dollars-----</u>
-------------------	----------------------------	----------------------------

*Beneficial Effects:*

- A. *The value to users of increased outputs of goods and services*

1. <i>Flood damage reduction -----</i>	<i>123,490</i>
2. <i>More intensive land use -----</i>	<i>46,470</i>
<i>Total Beneficial Effects -----</i>	<i>169,960</i>

---

*Adverse Effects:*

- A. *The value of resources required for a plan*

1. *All measures*

a. <i>Project installation -----</i>	<i>112,955</i>
b. <i>Project administration -----</i>	<i>15,530</i>
c. <i>OM&amp;R -----</i>	<i>12,675</i>
<i>Total Adverse Effects -----</i>	<i>141,160</i>

<i>Net Beneficial Effects -----</i>	<i>28,800</i>
-------------------------------------	---------------

---

1/ Average annual

**SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT  
Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska**

Components

Measures of Effects

*Beneficial and Adverse Effects:*

A. Areas of natural beauty

1. Treatment necessary to prevent wind and water erosion will be applied on 8450 acres of cropland and 5700 acres of rangeland.
2. Application of the following practices will change the visual landscape and have an effect on the natural beauty of the watershed:

<u>Practice</u>	<u>Amount</u>
Conservation cropping system	5,144 ac.
Irrigation ditch and canal lining	50,000 ft.
Land leveling	1,310 ac.
Irrigation water management	4,154 ac.
Pasture planting	140 ac.
Ponds	15(no.)
Terraces	166,428 ft.
Contour farming	1,300 ac.
Proper grazing use	2,500 ac.
Woodland tree planting	40 ac.
Upland wildlife habitat	514 ac.

3. Information and education program by the district will reduce pollution from agricultural fertilizer and pesticides.
4. The area burned by wildfire will be reduced 1600 acres per year.
5. Flood damage will be reduced as follows:

<u>Storm Frequency</u>	<u>Acres</u>
100-year storm	3244
10-year storm	2702
2-year storm	2016

*SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)  
Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

Components

Measures of Effects

6. *250 acres of idle land and 650 acres of low producing alfalfa will be put into more intensive crops such as corn or beets. This will affect the visual landscape.*
7. *Erosion above structures will be reduced by 1328 tons of soil per year, providing a more stable landscape.*
8. *Flood plain erosion scour will be reduced by an average 107,600 cubic yards annually.*
9. *Disturbance of 33 acres of irrigated land, 149 acres of non-irrigated cropland, and 179 acres of rangeland during installation of structural measures will cause these areas to differ in visual appearance from the surrounding landscape.*
10. *Five acres along the floodway road will be planted with adapted shrubs.*
11. *Reduced erosion and sediment rates will reduce the probability of sediment pollution in the South Platte River during large storms.*
12. *Installation of project measures will change the appearance of the landscape.*

*Part 2-3  
April 1974*

**SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)**  
*Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

Components

Measures of Effects

- |  |   |
|--|---|
| <p><i>B. Quality consideration of water, land, and air resources</i></p> | <p><i>13. Two hundred seventy-two acres of rangeland above the dams will be covered with sediment at the end of 100 years.</i></p> <p><i>14. 361 acres disturbed during construction of structural measures will be reseeded with adapted grasses, shrubs, and trees.</i></p> <p><i>15. 502 acres, presently rangeland, above the dams will be subject to periodic flooding for periods up to ten days. This area includes the 272 acres of sediment storage.</i></p> <p><i>16. Thirty-three acres of cropland will be converted to floodways.</i></p> <p><i>17. An average of 205 acres of lower-lying floodplain will not receive a deposition of sediment annually.</i></p> <p><i>1. Adequate treatment to protect the resource base will be applied on 8450 acres of cropland and 5700 acres of rangeland.</i></p> <p><i>2. Information and education program by the district will reduce pollution from agricultural fertilizer and pesticides.</i></p> <p><i>3. Smoke will be reduced by reducing the area burned by 1600 acres per year.</i></p> |
|--|---|

*SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)*  
*Sedgwick-Sand Draws Watershed*  
*Colorado*  
*Nebraska*

Components

Measures of Effects

4. *Land damaged by floods will be reduced as follows:*

<u>Storm Frequency</u>	<u>Acres</u>
100-year storm	3244
10-year storm	2702
2-year storm	2016

5. *Reduced sediment going into the canal system by 1328 tons per year.*
6. *Erosion scour to land on the floodplain will be reduced by an average of 107,600 cubic yards annually.*
7. *Disturbance on 33 acres of irrigated cropland, 149 acres of non-irrigated cropland and 179 acres of rangeland will increase dust in the air and increase the erosion rate on the 361 acres during installation of structural measures.*
8. *Engine exhaust from construction activities will add pollutants to the air.*
9. *Reduced erosion and sedimentation will reduce the probability of sediment pollution in the South Platte River during large storms.*
10. *502 acres above the dams, presently rangeland, will be subject to periodic flooding for periods of time up to 10 days.*
11. *33 acres of cropland will be converted to floodways.*

**SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)**  
**Sedgwick-Sand Draws Watershed**  
**Colorado**  
**Nebraska**

Components

Measures of Effects

C. Biological resources and selected ecosystems.

12. An average of 205 acres of lower-lying floodplain will not be covered with sediment each year.

1. The application of the following practices represents changes from the present condition:

<u>Practice</u>	<u>Amount</u>
Conservation cropping system	5,144 ac.
Irrigation ditch and canal lining	50,000 ft.
Irrigation pipeline	4,000 ft.
Irrigation water management	4,154 ac.
Pasture planting	140 ac.
Ponds	15 (no.)
Range seeding	100 ac.
Proper grazing use	2,500 ac.
Woodland tree planting	40 ac.
Upland wildlife habitat management	514 ac.

2. Information and education program by the district will reduce pollution from agricultural fertilizer and pesticides.

3. Ecosystems will be more stable by reducing the area burned by wildfire by 1600 acres per year.

4. Wildlife and ecosystems will be protected on the following acreage for different storm intensities:

<u>Storm frequency</u>	<u>Acres</u>
100-year storm	3244
10-year storm	2702
2-year storm	2016

**SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)**  
**Sedgwick-Sand Draws Watershed**  
**Colorado**  
**Nebraska**

Components

Measures of Effects

5. 250 acres presently idle and 650 acres of low producing alfalfa will be put to more intensive use which will cause changes in the present ecosystems.
6. Increased quantity and quality of crops on 5258 acres annually will affect the ecosystems where these changes occur.
7. Reduction of floodplain scour by an average of 107,600 cubic yards annually will encourage more stable ecosystems.
8. Disturbance of 361 acres during installation of structural measures will disrupt the ecosystems of the areas.
9. Two hundred of the 361 acres to be reseeded, will be seeded with species more suitable to wildlife habitat and food than the present vegetation.
10. The floodway through the Sedgwick Bar State Wildlife Area will provide floodwater protection to wildlife habitat.
11. Five acres along the floodway road on the Sedgwick Bar State Wildlife Area will be planted to shrubs for wildlife food and cover.

*SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)  
Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

Components

Measures of Effects

- |   |   |
|---|---|
| <p>D. Historical, archeological, and geological</p> | <ol style="list-style-type: none"><li>12. Vector and weed control as provided for in the Operation and Maintenance Agreement will affect the biology and ecosystems in these areas.</li><li>13. Reduced erosion and sediment rates will reduce the possibility of sediment pollution to the South Platte River during large storms.</li><li>14. 200 acres of the reseeding on areas disturbed during construction of structural measures will be established in plants desirable for wildlife habitat and food.</li><li>15. 502 acres above the dams, presently rangeland, will be subject to periodic flooding for periods up to ten days.</li><li>16. 33 acres of cropland will be converted to floodways.</li><li>17. An average of 205 acres of lower-lying floodplain will not be covered with sediment each year.</li></ol> |
|   | <ol style="list-style-type: none"><li>1. Reduced erosion rate, by 1328 tons per year, above structure site will preserve archeological resources in their associated soil strata for a longer period of time.</li><li>2. Reduced floodplain erosion scour, by an average of 107,600 cubic yards annually, will preserve archeological resources in their associated soil strata for a longer period of time.</li></ol>  |

**SELECTED ALTERNATIVE**  
**ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)**  
**Sedgwick-Sand Draws Watershed**  
**Colorado**  
**Nebraska**

Components

Measures of Effects

- |  |  |
|--|--|
| <p>E. Irreversible or irretrievable commitment</p> | <p>3. Disturbance of 361 acres during installation of structural measures may destroy the value of some unknown archeological sites and may lead to discovery of some unknown archeological sites.</p> <p>4. The installation of project measures will change the visual landscape of the area.</p> <p>5. 272 acres above the dams will be covered with sediment at the end of 100 years. Any archeological sites within this area will become more difficult to excavate as time passes.</p> <p>6. 502 acres, presently rangeland, above the dams will be subject to periodic flooding for periods of time up to 10 days.</p> <p>7. 33 acres of cropland will be converted to floodways.</p> <p>8. An average of 205 acres of lower-lying floodplain will not be covered with sediment each year.</p> <p>1. Land, labor and capital required for the application of the following land treatment measures represent an irretrievable commitment of resources as long as the measures are in effect:</p> |
|--|--|

**SELECTED ALTERNATIVE**  
**ENVIRONMENTAL QUALITY ACCOUNT (CONTINUED)**  
**Sedgwick-Sand Draws Watershed**  
**Colorado**  
**Nebraska**

Components

Measures of Effects

<u>Practice</u>	<u>Amount</u>
<i>Irrigation ditch and canal lining</i>	<i>50,000 ft.</i>
<i>Irrigation pipeline</i>	<i>4,000 ft.</i>
<i>Land leveling</i>	<i>1,310 ac.</i>
<i>Pasture planting</i>	<i>140 ac.</i>
<i>Ponds</i>	<i>15(no.)</i>
<i>Terraces</i>	<i>166,428 ft.</i>
<i>Range seeding</i>	<i>100 ac.</i>
<i>Woodland tree planting</i>	<i>40 ac.</i>
<i>Upland wildlife habitat</i>	<i>514 ac.</i>

- 2. *Firefighting equipment will be irretrievable as long as the burn reduction of 1600 acres per year is maintained.*
- 3. *Plant materials, labor and energy used to revegetate 361 acres disturbed during installation of structural measures will be irretrievable.*
- 4. *272 acres of rangeland above the dams will be committed to be covered with sediment by the end of 100 years.*
- 5. *Two hundred acres presently used as rangeland will be dedicated to wildlife use as long as the project is in effect.*
- 6. *502 acres, presently rangeland, above the dams will be committed to periodic flooding for periods of time up to 10 days as long as the project is in effect.*
- 7. *33 acres, presently cropland, will be committed to floodways as long as the project is in effect.*

**SELECTED ALTERNATIVE  
REGIONAL DEVELOPMENT ACCOUNT**

**Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska**

**Components**

	<b>Measures of Effects</b>	<b>1/ State of Colorado</b>	<b>Rest of Nation</b>
	-----	-----	-----
		<b>Dollars</b>	

*Income*

*Beneficial Effects:*

- A. *The value of increased outputs of goods and services to users residing in the region*

1. <i>Flood damage reduction</i> -----	123,490	---
2. <i>More intensive land use</i> -----	46,470	---

- B. *The value of outputs to users residing in the region from external economics*

1. <i>Induced by and stemming from effects</i> -----	17,810	---
--	--------	-----

<i>Total Beneficial Effects</i> -----	187,770	---
---------------------------------------	---------	-----

*Income*

*Adverse Effects:*

- A. *The value of resources contributed from within the region to achieve the outputs*

1. *All Measures*

a. <i>Project installation</i> -----	8,815	104,140
b. <i>Project administration</i> -----	920	14,610
c. <i>OM&amp;R</i> -----	12,675	0

<i>Total Adverse Effects</i> -----	22,410	118,750
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<i>Net Beneficial Effects</i> -----	165,360	-118,750
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*1/ Average annual*

*SELECTED ALTERNATIVE  
REGIONAL DEVELOPMENT ACCOUNT (CONTINUED)*

*Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

<u>Components</u>	<u>Measures of Effects</u>	
	<u>State of Colorado</u>	<u>Rest of Nation</u>
<i>Employment:</i>		
A. Increase in number and types of jobs		
1. Employment for project construction -----	76 semi-skilled jobs for one year	---
2. Employment for project OM&R -----	.6 permanent semi-skilled jobs	---
3. Agricultural employment -----	195 permanent semi-skilled jobs	---
Total Beneficial Effects -----	76 semi-skilled jobs for one year	---
	195.6 permanent semi-skilled jobs	

*SELECTED ALTERNATIVE  
REGIONAL DEVELOPMENT ACCOUNT (CONTINUED)*

*Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

Components

<u>Measures of Effects</u>	
<u>State of</u> <u>Colorado</u>	<u>Rest of</u> <u>Nation</u>

*Regional Economic Base and  
Stability*

---

*Beneficial Effects:*

*Project structural measures will be effective in decreasing peak flows, resulting in: (1) reduced area and depth of floodwater inundation, (2) reduced erosion and sediment transportation, (3) reduced damage to highways, railroad, residential and commercial properties, and (4) reduced damage from canal breaching. The resulting effects of these measures will be an improvement in the watershed environment and economy. The project will create 76 semi-skilled jobs for one year and 195.6 permanent semi-skilled jobs.*

*SELECTED ALTERNATIVE  
SOCIAL WELL-BEING ACCOUNT*

*Sedgwick-Sand Draws Watershed  
Colorado  
Nebraska*

Components

*Beneficial and Adverse Effects*

A. Real Income Distribution

1. Create 195 man-years of permanent semi-skilled employment
2. Create regional income benefit distribution of \$165,360. Flood damage reduction benefits by income class as follows:

<i>Income Class - Dollars -</i>	<i>Percentage of Adjusted Gross Income in Class</i>	<i>Percentage Benefits in Class</i>
Less than 3,000	18	29
3,000 - 10,000	56	62
More than 10,000	26	9

3. Local cost to be borne by region total \$22,410 with distribution by income class as follows:

<i>Income Class - Dollars -</i>	<i>Percentage of Adjusted Gross Income in Class</i>	<i>Percentage Benefits in Class</i>
Less than 3,000	18	9
3,000 - 10,000	56	67
More than 10,000	26	24

*Beneficial and Adverse Effects*

B. Life, health, and safety

1. Provide a one percent level of flood protection to 20 residences, one grain elevator, one railroad bridge, one street bridge, 1300 feet of railroad track, and 3000 feet of town streets in a 30-acre urban area.

S ENVIRONMENTAL EFFECTS

OBJ

	<p>176 acres. life and land, 224 acres.</p> <p>protect the</p> <p>16,524 acres. 9 acres. 176 acres nd, 5540 acres. munity services and, 15 acres. es. land, 283 acres. gs and improve- .ons and zoning. ting equipment.</p> <p>6,500,000.</p>	<p><b>Areas of Natural Beauty</b></p> <ol style="list-style-type: none"><li>1. Prevention of flood damage will allow visual improvements on 49 acres in and adjacent to the Town of Ovid.</li><li>2. Floodplain management (land use regulations and zoning) will encourage development of open and green areas.</li><li>3. Through establishment of shelterbelts as part of land treatment, provide for a diversity of landscape.</li></ol> <p><b>Quality Consideration of Water, Land and Air Resources</b></p> <ol style="list-style-type: none"><li>1. Maintain and improve the land resource quality by making needed land use changes and applying needed treatment.</li><li>2. Reduce surface wind velocities and dust and wind erosion by applying needed land treatment.</li><li>3. Improve water quality by reducing sediment in rainfall runoff as a result of applying needed land treatment.</li></ol> <p><b>Biological Resources and Selected Ecological Systems</b></p> <ol style="list-style-type: none"><li>1. Establish 584 acres of wildlife land.</li><li>2. Establish adequate treatment on 554 acres of wildlife land and woodland (wildlife habitat).</li><li>3. Floodways will create additional miles of "edge" effect for wildlife.</li><li>4. Improved management on rangeland will provide a greater variety of plants, improving wildlife food sources.</li><li>5. Reduced wildlife losses due to reduced wildfire.</li></ol> <p><b>Geological, Archeological and Historical Resources</b></p> <p>None</p> <p><b>Irreversible or Irretrievable Commitments</b></p> <ol style="list-style-type: none"><li>1. Labor and capital expended installing and maintaining the plan elements.</li></ol>
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*Environmental Quality Alternative  
Sedgwick-Sand Draws Watershed  
Colorado*

